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SIGNS MAINTENANCE
GUIDE.

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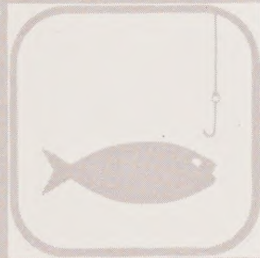
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signs maintenance guide

↑ ROWE 7
← TEX 9

Hot Creek

SPEED
LIMIT
15 MPH



National Forest
LAND

WELCOME

Hunting and Fishing
under State Fish and Game

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LAND PASS

ON 11,988 FT.

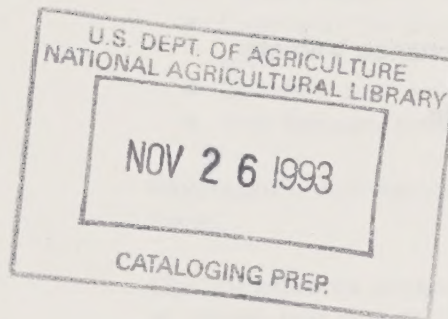
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ARAPAHO
National Forest



signs maintenance guide



October 1979

by

Tom Nettleton
Project Leader

Forest Service
Equipment Development Center
Missoula, Montana

contents

- 1 Introduction
- 3 Inspection and Records
- 11 Vandalism
- 17 Sign Cleaning
- 21 Sign Repair
- 29 Safety
- 39 Materials and Handtools
- 43 Commercial Sign Repair Kits
- 45 Heavy-Duty Equipment
- 47 Sign Maintenance Vehicle
- 55 Sign Storage
- 57 Appendix

Information contained in this report has been developed for the guidance of employees of the Forest Service, U. S. Department of Agriculture, its contractors, and its cooperating Federal and State agencies. The Department of Agriculture assumes no responsibility for the interpretation or use of this information by other than its own employees.

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Introduction

The Forest Service manages one of the largest transportation systems in the world. National Forest lands contain some 250,000 miles of roads stretching across all types of terrain and traveled in every kind of weather. The Forest Service relies on modern traffic engineering measures to make these roads as safe as possible. None are more important than the installation and maintenance of traffic control signs.

Safe, efficient traffic movement depends on these signs. To be effective, signs must:

- Fulfill a need.
- Command the attention and respect of the road user.
- Convey a clear, simple message.
- Give adequate time for proper response.

High-quality, well-maintained signs meet these requirements.

Sign maintenance programs must meet high standards to assure that sign legibility is retained, the sign is visible, and it is removed when no longer needed. Clean, legible, properly mounted signs command the respect of motorists and pedestrians. On the other hand, careless maintenance can destroy or reduce the value of a sign. The effectiveness of the total sign system is only as good as the maintenance.

This document is a guide to good maintenance practices. It presents methods for inspection, repairing, refurbishing, cleaning, and replacing traffic control devices and their mountings in the field. Some of the maintenance methods are shown in step-by-step illustrations. A list of recommended tools, supplies, and suggested documentation for inspection and maintenance records is included.

Inspection and Records

Personnel trained in sign inspection and maintenance should inspect *all* signs once a year. Signs along roads open year-round should be inspected twice a year. A sign should be inspected for:

- Legibility.
- Reflectivity.
- Overall condition.
- Minimum height above the road shoulder.
- Proper location.

Sign mountings should also be inspected, and weeds and brush around the mounting removed to insure that the sign remains legible from the roadway.

A sign inspection and inventory sheet (see page 4) may be helpful in managing your sign inspections. It can be used to verify and update your District and Forest sign plan. It also provides written proof that your sign system is current and legal.

Reflectorized signs must be inspected at night as well as during the day to insure nighttime legibility. This is a requirement of Highway Safety Program Standard 13, *Traffic Engineering Services*, which is reprinted in the appendix.

The problem of night safety on roads is acute. Statistics show that while only one-third of road traffic moves after dark, over half the fatalities (53 percent) occur at night. Underscoring the importance of sign reflectivity is the fact that 90 percent of a driver's actions result from decisions made based on what he sees.

Night inspection, and maintaining nighttime legibility, is a vital part of any sign maintenance program.

Recordkeeping is another important aspect of sign maintenance. One of the most important documents is the sign maintenance record (see page 5), the sign maintenance crew's primary working tool. The sign maintenance record can be used to measure the cost effectiveness of signs—how much maintenance is required; would it be cheaper to replace than repair. It is also wise for each crew to keep a logbook or diary of its daily activities. This type of record has proven valuable to State and county agencies defending against tort claims.

[illegible]

Signed By _____ Date _____

Sign Maintenance Record

District or Zone	Sign Location
Wording on Sign	

Type of sign: ☐ Redwood ☐ Plywood ☐ Other (specify) _____

Type of sign mounting: ☐ Wood ☐ Concrete ☐ Metal ☐ Masonry

Repairs need for mounting:

Type of sign maintenance required: ☐ Routine ☐ Special (Explain) _____

Replaced sign parts shall be: ☐ Returned to Engineering Storage Yard
☐ Disposed of in a sanitary landfill

Remarks:

Prepared by	Title	Date
-------------	-------	------

Inspecting Nighttime Reflectivity

- With masking tape, affix 10- by 8-inch sign inspection guide to clean section of the sign. Forest and District sign coordinators can obtain sign inspection kits from 3M Co., Reflective Products Division, St. Paul, Minn.

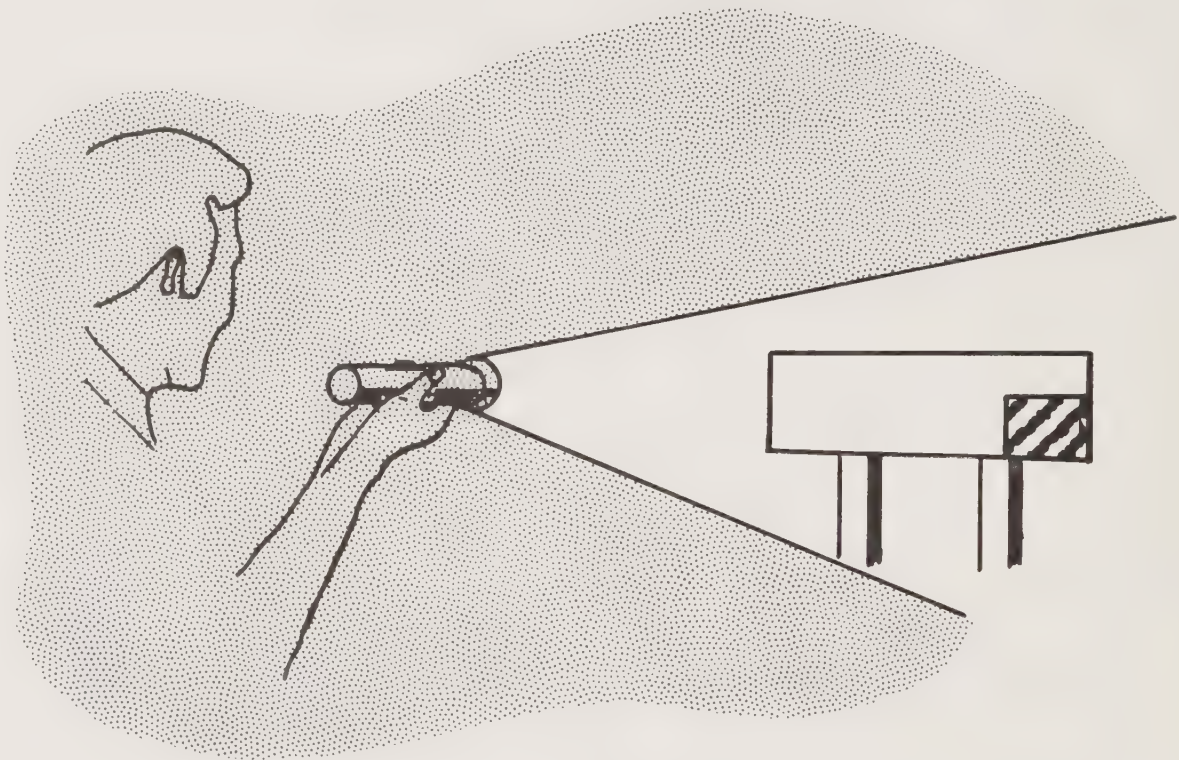
- Step back about 30 feet. Hold flashlight about 2 inches from your eyes and shine it at the sign. Do not use vehicle headlights.

- If the inspection guide is brighter than the sign, the sign should be replaced within the year.

- If the sign is brighter than the inspection guide, the sign will not have to be replaced for a number of years.

- If the sign and the inspection guide appear of equal brightness, the sign has from 1 to 2 years of useful life left.

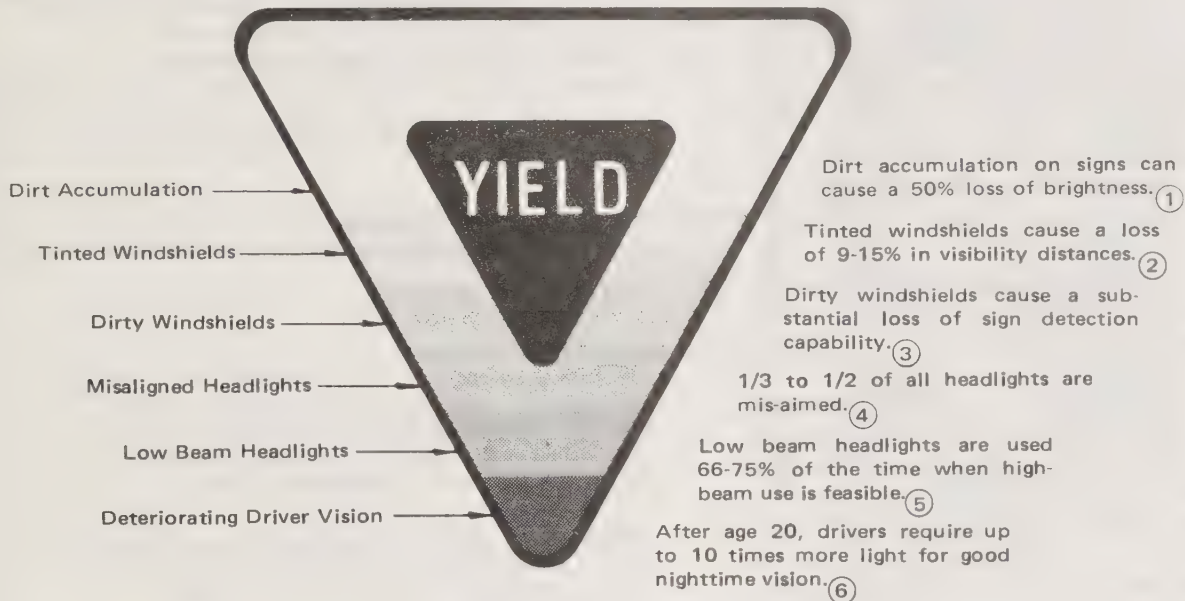
As experience is gained in this test procedure, it becomes easier to evaluate reflective brilliance without using the inspection guide on each sign. With enough experience, the inspection guide is only needed for questionable cases.



RATIONALE BEHIND NIGHT INSPECTION & FIELD CLEANING

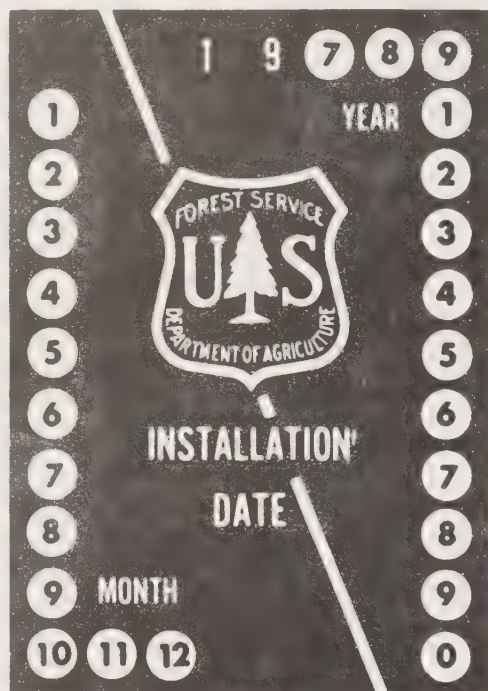
As more automobiles take to National Forest roads, traveling at higher speeds, the problem of nighttime traffic safety becomes increasingly acute. Statistics show that while only about 33-1/3% of vehicular traffic moves after dark, 53% of traffic fatalities occur at night. A large part of the problem is caused by the restricted visibility motorists encounter in the nighttime driving environment. The importance of sign reflectivity is underscored by the fact that 90% of drivers' actions result from decisions made on what they see. This is why the Highway Safety Act of 1966 (Standard 13) requires night inspection and maintenance of traffic control devices.

Nighttime legibility is affected by:



- ① Source: "Vehicle Spray Pattern Study," investigation No. 338, Traffic Engineering Section, Minnesota Highway Department, 1966.
- ② Source: "Safety Hazard of Tinted Automobile Windshields at Night," Institute of Transportation and Traffic Engineering, UCLA, 1955.
- ③ Source: "Night Visibility Improvement Through Headlight Glare Reduction," Roger H. Hemion, Southwest Research Institute, 1969.
- ④ Source: "Controlling Headlamp Aim," Professor D.M. Finch, College of Engineering, University of California, Berkeley, 1971.
- ⑤ Source: "Headlight Beam Usage on U.S. Highways," Charles T. Hare and Roger H. Hemion, Southwest Research Institute.
- ⑥ Source: "Experimental Studies of Night Vision as a Function of Age and Changes in Illumination," Ross A. McFarland and Richard G. Domey, Harvard School of Public Health.

SIGN INSTALLATION DATE MARKERS



SIGN INSTALLATION
DATE MARKERS
(ACTUAL SIZE)

These markers are required to comply with the Forest Service—FHWA memorandum of understanding (FSM 1535) for Highway Safety Program Standard No. 13, "Traffic Engineering Services," Sections C-1, C-2, C-3, D-2, and D-6. The markers are required on all guide, warning, and regulatory traffic control devices.

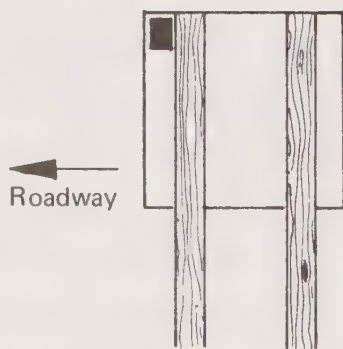
Legend is white on black. Film material has pressure-sensitive adhesive.

Show the installation date by:

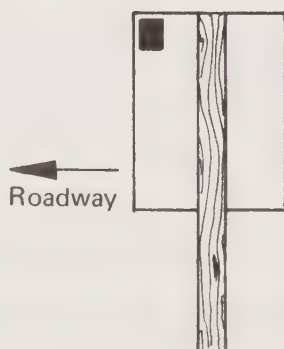
- Punching out the month on the left side of the marker.
- Punching out the last two digits of the year on the right side of the marker.

By noting the position of the punch-out dates, it will be possible to read the marker from as far away as 20 feet. This will aid in sign replacement scheduling on road condition surveys, in traffic control device inspections, and in tort claims and litigation.

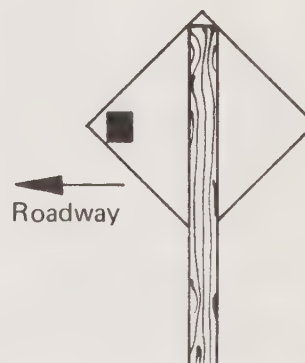
These devices will be stocked in central supply and by the Regional Sign Coordinator. They will also be shipped in sign orders from contract suppliers.



GUIDE SIGNS



REGULATORY SIGNS



WARNING SIGNS

TYPICAL PLACEMENT ON SIGN BACK
(CORNER NEAREST ROADWAY)

General Maintenance Tips

- Try not to spend time and money repairing nonstandard traffic control devices. Instead of repairing them, replace them with standard devices that conform to law and Federal regulations (see the *Manual on Uniform Traffic Control Devices*).
- Do not set out to maintain roadside signs without all the appropriate advance warning signs and devices needed to protect safety of motorists and workers at each site.
- Careless sign maintenance can do more harm than good. Do it well—or don't do it at all.
- When reinstalling repaired or replacement signs, tighten up the sign bolts snug, but not too tight. Tightening bolts too tightly ruptures both the reflective sheeting and the plywood overlay. These ruptures lead to premature sign failure. Use theft-resistant nuts (Pyrnuts) when reinstalling signs. Place a nylon washer between the bolt head and the sign face to reduce chances of rupturing the sign face.
- The adhesive on reflective sheeting has a shelf life of about 1 year when stored under "average" conditions. This adhesive may remain satisfactory for up to 2 years when stored under ideal cool, moist conditions. If carelessly stored and handled under the worst possible hot conditions, the adhesive can lose its tack in 7 to 9 months. Tackiness can sometimes be restored with a light, even coat of 3M Co. A-3 Activator. So when you buy replacement components for your maintenance kits, buy what you need—don't over buy.
- Much of the reflective sheeting on signs is made of vinyl or acrylic plastics. These plastics are petroleum based. One of the quickest ways to destroy these plastics is to contaminate them with Forest Products Laboratory stains or creosote-bearing stains. When you are staining posts, take care not to get stain on the sign face.

Vandalism

The problem of vandalism cannot be overlooked in a sign maintenance program. Defacement and destruction of signs occur on every Forest. Vandalism ranges from scribbles, gunshots, and painting to outright theft. According to State highway department records, 3 to 9 percent of all signs in place are stolen every year. To combat vandalism, consider including these steps in your sign maintenance program:

- Use materials that continue to perform the signing function, even though marred. Plywood substrate reduces the effect of bullet damage.
- Use vandal-resistant hardware to prevent the sign from being easily loosened and carried away.
- Use anchor rods or cleats at the bottom of the signpost to prevent its rotation or removal.
- Place signs that must be close to the roadway at the maximum practical mounting height. Do not locate signs near pullouts if it can be legally avoided.
- Place signs away from the edge of the pavement using the maximum lateral offset where possible.
- Place a Forest Service emblem on the sign to identify it as an official device. This will aid in prosecuting vandals.
- Place vandalism warning decals on all signs so would-be vandals know the penalties imposed by law.

WILLFUL DEFACERS OF
FOREST SERVICE NOTICES
SUBJECT TO CRIMINAL
PROSECUTION WHICH MAY
RESULT IN A FINE AND
OR IMPRISONMENT

18 USC § 1361
\$10,000 FINE AND/OR 10 YEARS
36 CFR § 261.4 (1975)
\$500 FINE AND/OR 6 MONTHS

Note—Available from central
supply: Poster No. 64-11 or
No. 64-11a.

Decal will not affect
the color or reflectivity
of sign.

TYPICAL WARNING
(ACTUAL SIZE)



GUIDE SIGN
WHITE LEGEND ON
TRANSPARENT FILM



REGULATORY SIGN
BLACK LEGEND ON
TRANSPARENT FILM

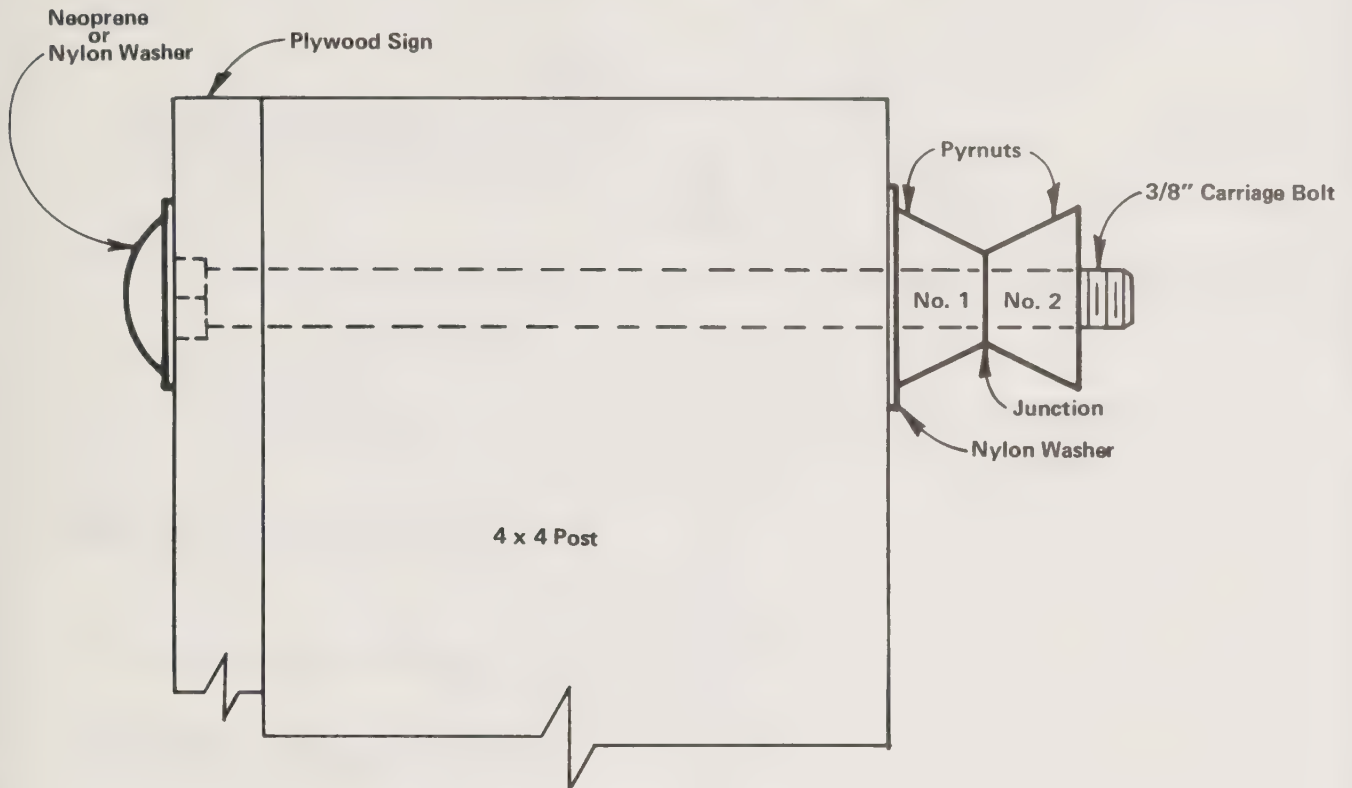


WARNING SIGN
BLACK LEGEND ON
TRANSPARENT FILM
RT. OR LT. CORNER

TYPICAL PLACEMENT

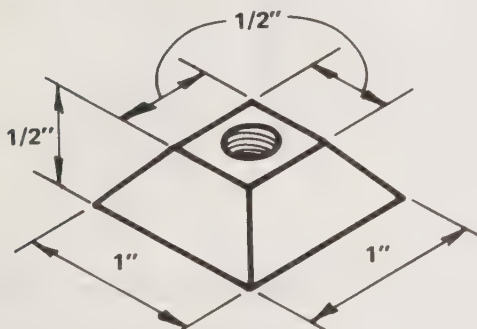
VANDALISM WARNING DECAL

Sign Installation Hardware **"Pyrnuts" (Pyramidal nuts)** **Anti-theft, Anti-vandal Fasteners**



Typical Installation Procedure

- Step 1:** Install first Pyrnut (No. 1) finger tight as shown.
- Step 2:** Install second Pyrnut (No. 2) finger tight as shown.
- Step 3:** Insert wrench at junction to tighten (or loosen) as necessary.
- Step 4:** Remove Pyrnut No. 2, then installation is complete.



Typical Pyrnut
 (for 3/8" Carriage Bolt)
 Item S-29(7)

Minimum Order-100

Single Pyrnut is difficult to remove because of its shape.
 Always use (4) Pyrnuts for each sign installation.

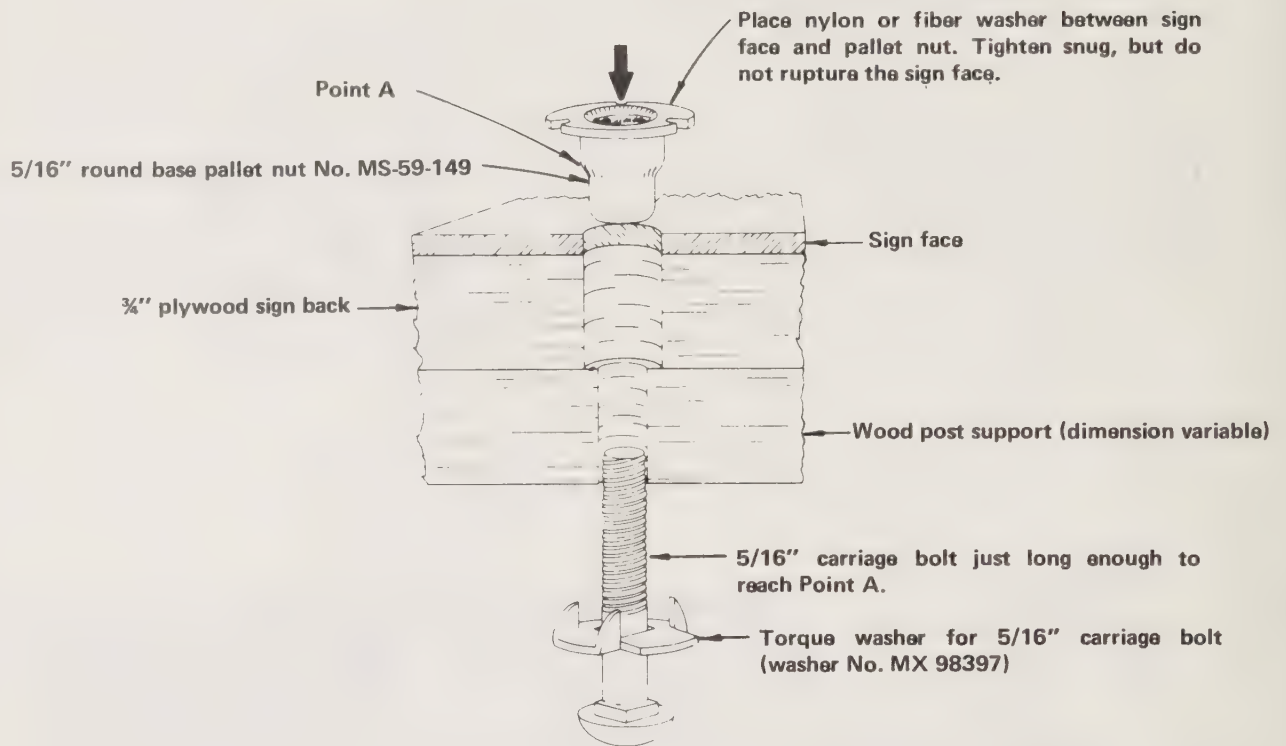
Available from:

Ojo Caliente Craftsmen Inc.
 Ojo Caliente, N. Mex. 87549

(Not to Scale)

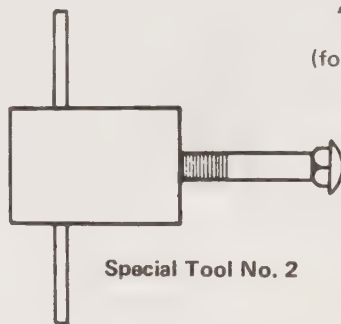
Theft-resistant Sign Fasteners

Use 5/16" Allen Wrench



"Teenut" Pallet Fastener

(for 4" x 4" wood post supports)

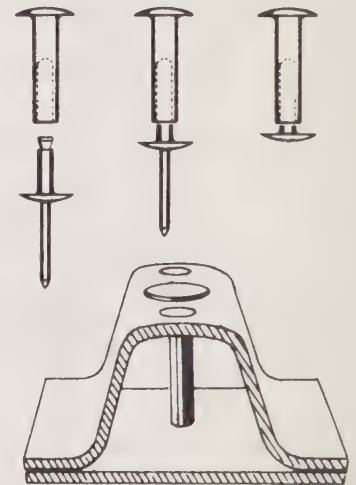


No. TPA 2516 (2")
No. TPA 3516 (2 1/2")

Aluminum Fluted Nuts

(For aluminum delineators and signs on "U" channel posts)

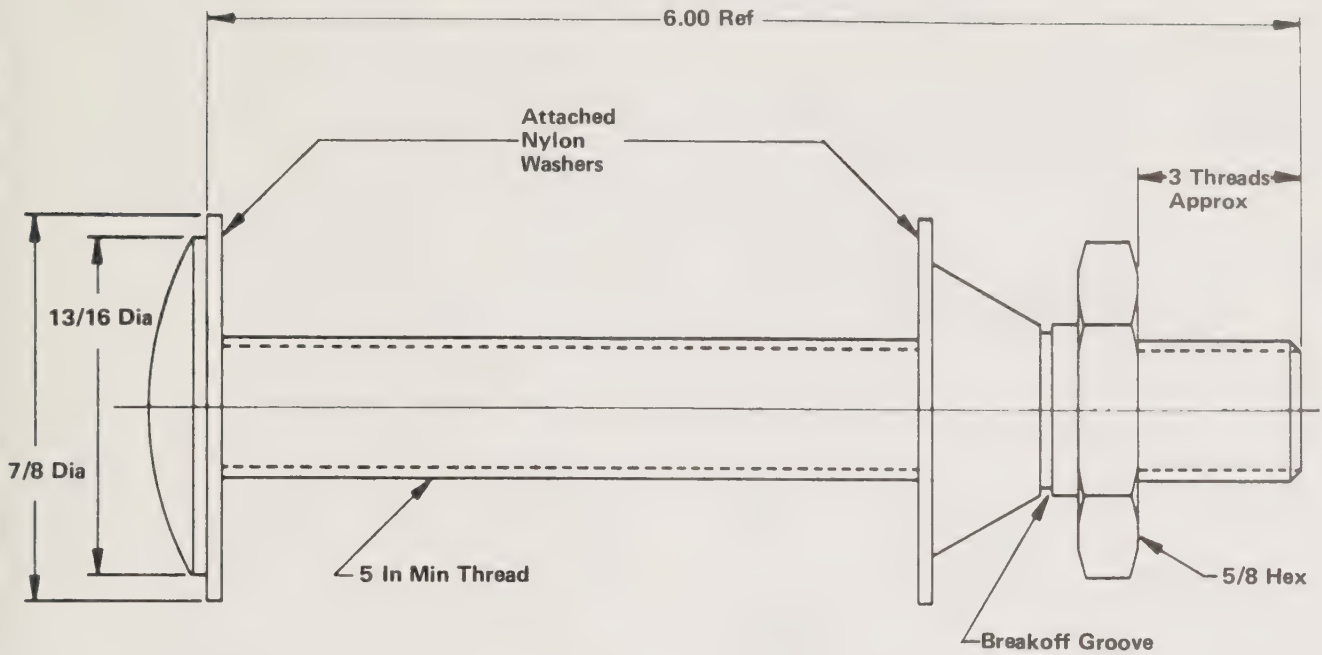
Available from:
Carr Fastener Co.
Cambridge, Mass.



Blind Aluminum Rivets

(For aluminum and 1/2" plywood signs on "U" channel posts)

Vandlgard-Nut Assembly



HARDWARE ASSEMBLY

ASSEMBLY COMPONENTS	DESCRIPTION	MATERIAL	FINISH & COLOR
VCB 144	Bolt—5/16-18 x 6" Round head	C1018 Steel or equiv.	Cadmium plate per QQ-P-416 Type II Cl. 2 or zinc plate per QQ-Z-325 Type II Cl. 1 } Olive drab Dichromate
VCN 145-5	Nut—5/16-18 Vandlgard	Aluminum alloy QQ-A-430	Anodize per MIL-A-8625 Color: Green
VCW 146	Washer—5/16 I.D. x 7/8 O.D. x 1/16" thick	6/6 Nylon	Brown

VC147 Hardware assembly consisting of:

- 1 VCB144 bolt with attached VCW146 washer
- 1 VCN145-5 nut with attached VCW146 washer

NOTES: 1. Assembly supplied as illustrated.

2. To order individual components use the following part numbers:

Bolt:
VCB144—Bolt without washer
VCB144W—Bolt with attached washer

Nut:
VCN145-5—Nut without washer
VCN145-5W—Nut with attached washer

Washer:
VCW146—Washer only

Available from:

Federal Prison Industries
or
Vol-Shan, P.O. Box 512,
Culver City, Calif. 90230

Sign Cleaning

Signs must be kept clean to insure their legibility. This is particularly true of reflective signs, which must be dirt-free for maximum reflectivity.

Equipment Needed

- Pickup truck equipped with tank or a number of 50-gallon drums to hold water supply.
- Portable pump and hose with appropriate nozzle.
- Soft-bristled brush or sponge that connects to the hose so a stream of water flushes through it.

Special sign cleaning equipment such as the "Highway Handyman" sign cleaner are available for a variety of trucks. These units have pumps, selective valving, and cleaning head brushes to accomplish the cleaning. The valving allows either solutions of detergent and water or plain water to be run through the brushes.

Purchase information for the "Highway Handyman" can be found on page 45.

When cleaning, take care not to abrade the sign by using stiff-bristle brushes or by unnecessary scrubbing.

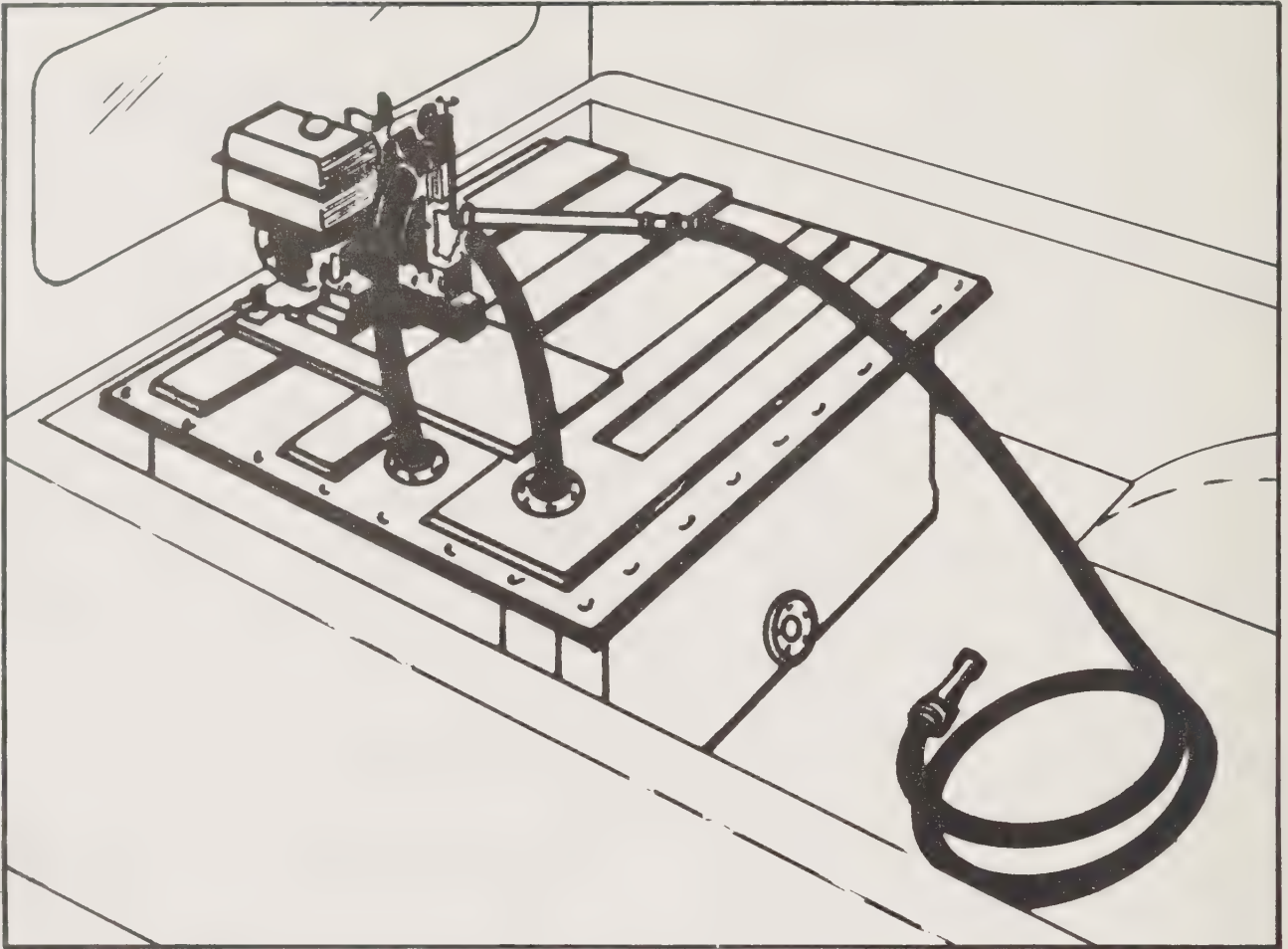
- Mild, nonabrasive detergent suitable for high-quality painted surfaces. Detergent must be free of strong aromatic solvents or alcohols, and chemically neutral. A list of cleaners tested for engineering-grade sheeting is available from the 3M Co. (L-IF151).

Washing Signs

- Flush surface with a soft brush, rag, or sponge, using suitable detergent or other cleaner.
- Flush sign surface with clean water to remove loose dirt.
- Wash sign face with soft brush, rag, or sponge, using detergent or other suitable cleaner. Wash from top down. Avoid abrading the surface with unnecessary scrubbing. Once suds have been applied, keep a steady stream of water flowing on the sign face to wash away dirt.
- Rinse entire sign face with clean water. Allow to dry. If a sign is to be clear coated, it must dry thoroughly first.

1

Cleaning Signs in the Field



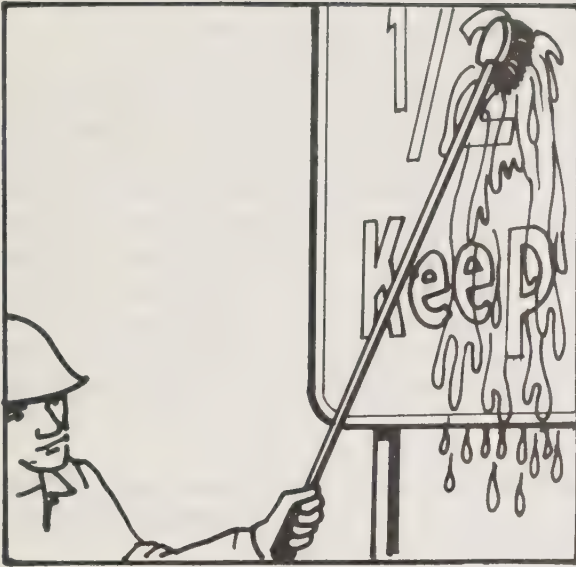
Have truck outfitted with sign cleaning unit, or 50-gallon drums for water supply and portable pump and hose.

2



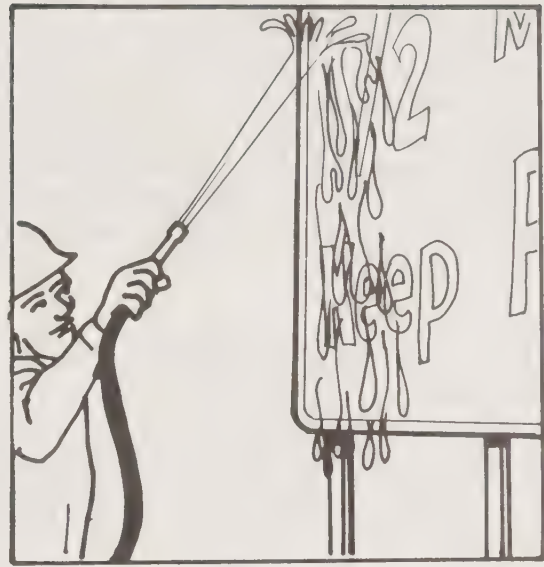
Use soft-bristled brush or sponge that connects to hose.

3



Flush the surface with clean water to remove loose dirt particles. A squeeze or triggered hose nozzle is convenient for this purpose. Wash the sign face with a soft brush, rag or sponge, using mild nonabrasive detergent. Wash thoroughly from the top down; avoid abrading the surface with unnecessary scrubbing. Once suds have been applied, keep a steady stream of water flowing on the sign face to wash away dirt particles.

4



Rinse the entire face with clean water. Allow to drain dry. If a sign is to be clear coated, it must thoroughly dry before clear application.

Special Cleaning Procedures

- **Tar, oil, diesel smut, bituminous material.** Use a mild solvent such as mineral spirits. Then wash the surface with mild detergent and water and rinse with clean water.
- **Pollen and fungus.** Wash the surface with a 3 to 5 percent sodium hypochlorite solution such as a commercial brand of bleach, followed by detergent and water. Rinse with clean water.
- **Lipstick and crayon.** Use a mild solvent such as mineral spirits to remove the material. Follow with detergent and water and clean water rinse.
- **Paint.** It may be possible to remove paint sprayed onto a reflective sheeting sign face using a commercial

paint remover designed for this purpose. The type of paint, length of exposure, and type of remover used may affect the life of the sheeting. Following cleaning, clear coating may be needed.

- **Other severe contamination.** Soiling that cannot be removed by these methods can be removed by scrubbing with a "Scotch-Brite" pad, very fine steel wool, or plastic kitchen scourer. Unless great care is taken, this scrubbing destroys all or part of a sign's night reflectivity. If cleaning results are poor, consider covering contaminate with 3M Co. No. 425 UAL aluminum foil tape and applying a new patch of reflective sheeting over the tape. Where cleaning results are good, rinse and dry thoroughly. Clear coat scrubbed area to restore night reflectivity.

Clear Coating Reflective Signs

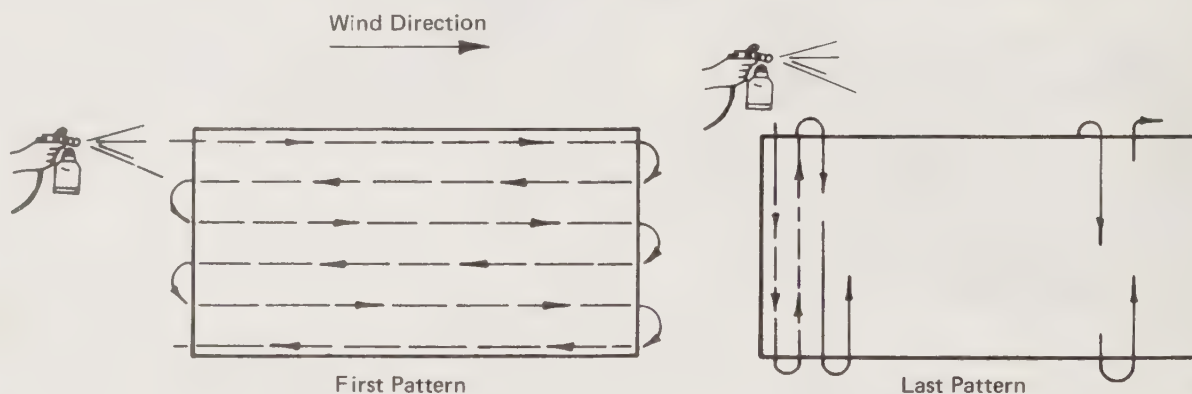
The useful life of a sign with low reflectivity can be extended 1 or 2 years by clear coating. For a large number of signs, spraying or hand rolling generally is most economical. Small signs can be brushed. Thoroughly wash and dry sign beforehand. Temperatures should be 50° F or above for best clear-coating results. Do not clear coat sign on excessively windy days or when raining. **Do not clear coat high-intensity sheeting.**

Spraying. A spray gun using a remote pressure pot is recommended for large signs. Fluid tips and air caps suitable for enamels are generally satisfactory. Start on upwind edge of sign. Wind carries spray onto the uncleared portion of the sign and as spraying proceeds, any overspray is flooded with a full glossy

coating. For uniform coverage, spray sign with horizontal pattern, then vertical pattern.

Roll coating. Wash new rollers with detergent and water, then rinse and dry to remove loose fibers. Starting at the top and working down, roll back and forth across the sheeting to deposit an even, wet, glossy coat. A final roll in one direction with the roller perpendicular to the first application is helpful in obtaining even, clear distribution. On large signs, finish one section at a time and avoid rerolling an area that has started to dry. Extension handles, available at most paint stores, may eliminate the need for a scaffold.

Hand brushing. Small signs—brush evenly. Check light reflection from surface of clear coated sign to verify no skipped areas exist.



SIGN CLEARING CHART—ENGINEERING-GRADE SHEETING

	Spraying	Roll coating	Hand brushing
Equipment	Binks 18 or 19 gun fluid tip-63A air cap 63PH or 66PE or equivalent. Remote fluid pressure tank.	1/8"-1/4" nap mohair roller or lambs wool covered with cotton enameling sleeve or pressure fed roller extension handles.	3"-4" enameling brush
Clear (No. 731)¹	finishing clear 731	finishing clear 731	finishing clear 731
Thinner (No. 711)²	thinner 711	thinner 711	thinner 711
Pints of thinner per gallon of clear³ for air temperature:			
85°-100° F	1 pt/gal	1 pt/gal	2 pt/gal
65°-85° F	2 pt/gal	2 pt/gal	3 pt/gal
50°-65° F	3 pt/gal	3 pt/gal	3 pt/gal

¹No. 731 is a 3M Co. product.

²No. 711 is a 3M Co. product.

³Do not add additional thinner until it is determined that atmospheric conditions require it. Once additional pint may be added if required.

Sign Repair

First, determine if the sign should be repaired, replaced, or left as is. This is usually a field judgment. More often than not, it is cheaper to replace a badly damaged or illegible sign than to attempt extensive repairs. Compare repair costs (and likely extended sign life) with new sign cost and service life when deciding whether to repair or replace a sign.

REFLECTIVE ALUMINUM SIGNS

Bent Signs

A bent sign can often be restored simply by straightening, if the reflective background or legend has not been scraped or severely damaged. Where it has:

1. Straighten the sign and remove all background sheeting and legend from an area slightly larger than that damaged.
2. Clean exposed surface with Xylol; then varnish maker's and painter's (VM&P) naphtha.
3. Apply matching pressure-sensitive reflective background sheeting, extending it at least ½ inch beyond the damaged area.
4. Replace damaged legend with die-cut, pressure-sensitive, prespaced letters, borders, and symbols, and firmly squeegee in place.
5. Edge seal new background sheeting and legend with 3M Co. No. 700 edge sealer. If sign is subjected to snow burial and replacement sheeting extends to the top edge of sign, place 3M Co. transparent film (No. 639) along top edge.

Bullet Holes or Punctures

Many times it is not necessary to repair each hole in the sign. When a bullet hole does not damage the message or symbol and does not, of itself, create a sloppy signing image for the Forest Service, ask yourself, "Is repair really needed?" Where repairs are needed, follow these steps:

1. Remove all damaged background sheeting and legend.
2. Straighten the sign using a hammer and flat dolly.
3. Remove any additional sheeting damaged during straightening.

4. Clean the entire area with Xylol; then VM&P naphtha.

5. Patch the bullet hole or puncture on both sides using 3M Co. No. 425 UAL aluminum foil tape. Use your squeegee to apply firm pressure. Do this on both sides of the sign. On large holes, start placing the foil at the bottom of the hole, overlapping each strip shingle fashion as you move up.

6. Apply reflective background sheeting, extending it at least ½ inch beyond the foil tape strips.

7. Replace damaged legend with die-cut, pressure-sensitive, prespaced letters, borders, symbols and firmly squeegee in place.

8. Seal edge of new background sheeting and legend with 3M Co. No. 700 edge sealer. If the sign is subject to snow burial and replacement sheeting extends to the top edge of sign, place 3M Co. transparent film (No. 639) along that top edge.

REFLECTIVE PLYWOOD SIGNS

Bullet Holes or Punctures

Where repairs are needed to restore a sign's legibility, follow these steps:

1. Remove all loose wood on both sides of the sign and all damaged sheeting.

2. Fill holes with wood filler if necessary and sand smooth.

3. Wipe area with clean cloth.

4. Cover holes on both sides of sign with 3M Co. No. 425 UAL aluminum foil tape. Use your squeegee to apply firm pressure. Do this on both sides of the sign. On large holes, start placing the foil at the bottom of the hole, overlapping each strip shingle fashion as you move up.

5. Apply reflective background sheeting, extending it at least ½ inch beyond the foil tape strips on face of the sign.

6. Replace damaged legend with die-cut, pressure-sensitive, prespaced letters, borders, symbols covered by the patching and firmly squeegee in place.

7. Seal edge of new background sheeting and legend with 3M Co. No. 700 edge sealer. If the sign is subjected to snow burial and replacement sheeting extends to the top edge of sign, place 3M Co. transparent film (No. 639) along top edge.

8. Using an aerosol can of flat black enamel, lightly spray the aluminum tape covering the holes on the sign back. Keep paint off the sign face as this destroys reflectivity.

ROUTED WOOD SIGNS

Repairing Signboard

1



Scrape off loose paint with a wire brush. Dress all bullet holes and damaged wood with a knife.

2



Fill all cracks, holes, and imperfections with wood filler.

3



Using a portable electric sander, or pneumatic sander, sand sign edges, back, and face. (Sand edges only, if black HDO.)

4

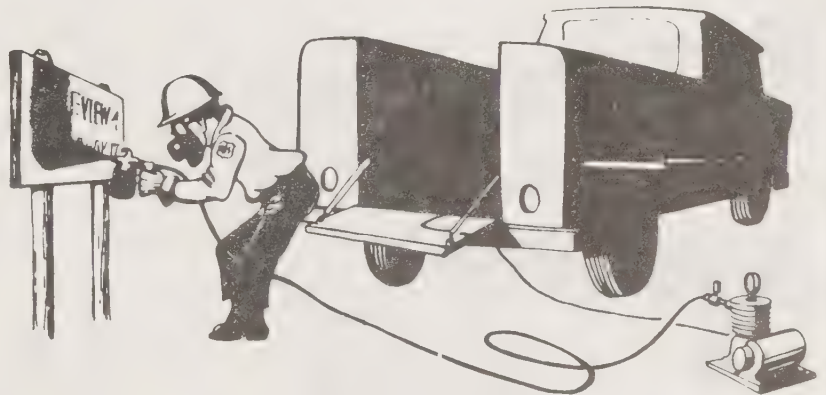


Dust off sign with airhose or tack rag. Be sure the signboard is free of loose paint, dust, and other foreign materials.

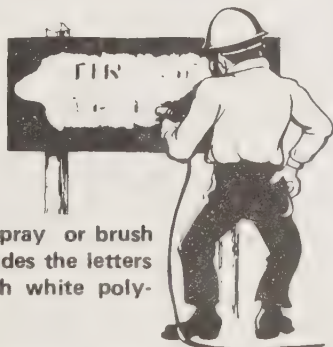
Painting

1

If the sign has not been primed (either when manufactured or when previously maintained), apply one coat of polysilicone enamel with brush, roller, or spray gun. A brush is excellent because the paint can be worked into all corners and cracks. If spray painting, take care to thoroughly cover all parts of the sign so no bare wood is left exposed.



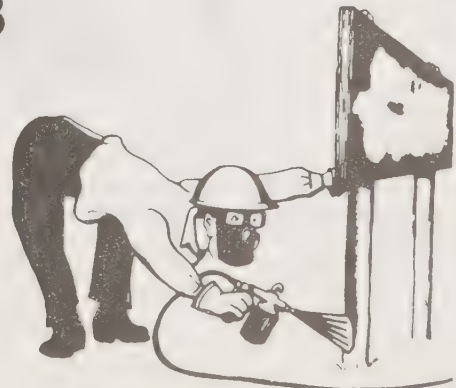
2



After the first coat is dry, spray or brush the message area (this includes the letters and surrounding area) with white polysilicone enamel.

Give message area two finishing coats with brush or spray gun. Work paint into all corners of letters and numbers to seal out moisture completely because the protective overlay has been routed away.

3



While message enamel is drying, paint the posts and background with brown polysilicone enamel.

4

After the message enamel has dried enough so background enamel can be rolled over it without smearing, apply background enamel over entire sign face. Use a 1/8-inch-thick polysponge roller; standard fabric rollers spread paint into the routed area. Avoid getting too much paint on the roller and use light pressure on the sign surface. Because of this, it is difficult to cover the message paint quickly. Moving the roller in a crisscross pattern may speed coverage. A polysponge roller tends to trap air. Eliminate bubbles by rolling the surface with a dry polysponge roller.

Apply two additional finishing coats of background enamel. The second coat should be allowed to dry thoroughly before applying the last coat.



5



Touch up letters with an artist's brush if background paint has slopped into message.

Staining

1

Prepare sign surface as in steps 1 through 4 under "Painting."

2

Hand paint message area with polysilicone enamel, using artist's brush. Keep enamel off sign face.

3

After the message enamel has dried, apply two coats of Forest Products Laboratory cedar stain by brush or polysponge roller.

4

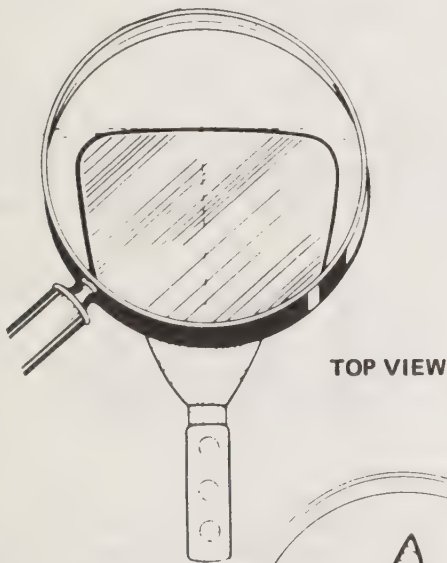
Touch up message as required.

Replacing Damaged Reflective Background Sheeting and Legends in the Field

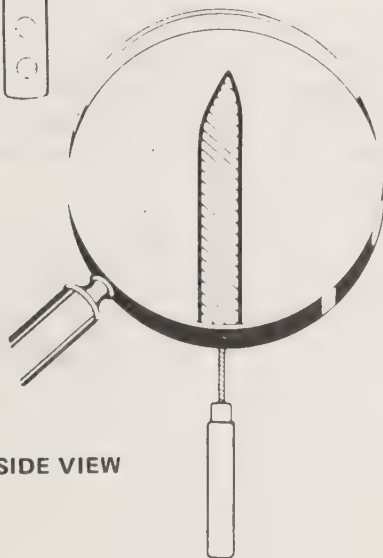
Removing Damaged Sheeting

Removing reflective sheeting legend or background in the field is best done with a sharp, beveled putty knife and heat gun, blowtorch, or heat lamp. Heat softens the sheeting so that, with care, the damaged portion can be scraped off. It is a four-step operation:

1. Clean sign surface and area around the background or legend to be removed.
2. Heat the section to be removed.
3. Work putty knife under sheeting edge and strip the sheeting from the adhesive.
4. Remove adhesive remaining on sign face with cloth dampened with Xylol.



TOP VIEW

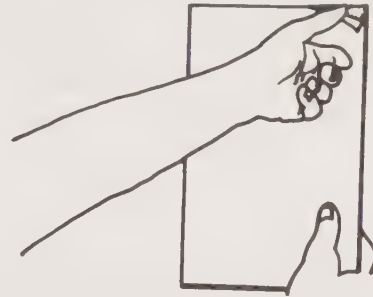


SIDE VIEW

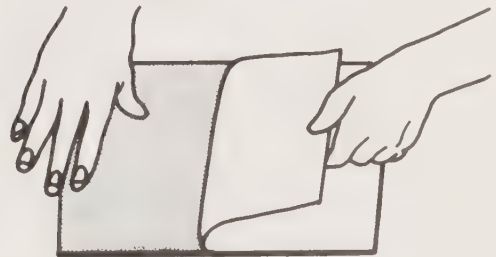
Spot Patching Background

Once sheeting is removed, clean any oil, grease, or dirt from the application surface by wiping with mineral spirits or varnish maker's and painter's naphtha. After cleaning, wipe surface dry with clean rag. You are now ready to apply the sheeting.

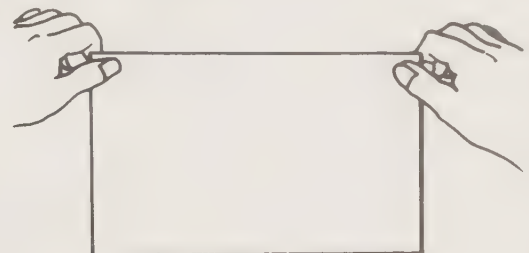
Remove the liner by sharply flicking the sheeting edge toward the front face with the ball of the thumb or fingernail.



Place sheeting face down on clean, dust-free surface and remove the liner. When temperature is below 50° F, activate adhesive with 3M Co. A-3 Activator.



Gently position the sheeting on the application surface, overlapping surrounding sheeting by at least ½ inch. Avoid any pressure on the sheeting to prevent premature sticking. Then tack the sheet in place by finger pressure at two points on the upper edge.



When sheeting is positioned, press it firmly to the surface with a squeegee, using overlapping strokes, starting at center and working out to edges.

Initial squeegee pressure must be very firm to avoid forming air pockets when nearing the upper corners. Lift these corners back beyond the points at which the sheet was tacked to the surface. This prevents wrinkles at the tack points as the application proceeds to the edges.

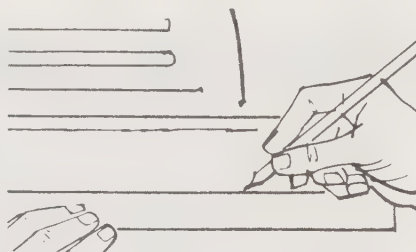
Re-squeegee the edges using very firm pressure. Then wipe the face of the patch sheeting and the squeegee with a soft cloth to remove any surface dust.

For maximum durability, edge seal with 3M Co. No. 700 edge sealer. Apply with felt dauber or hand brush.

Now go on to repair any damaged legend.

Repairing Legend, Borders, and Symbols

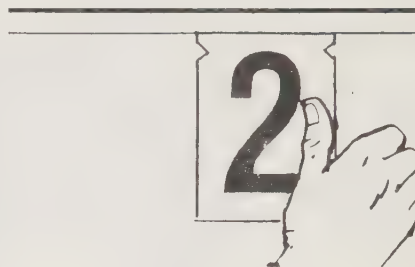
As a guide for top alignment of the legend, border, or symbol, mark a straight, horizontal line on the sign.



Lay first character on a flat surface and carefully remove the protective liner.



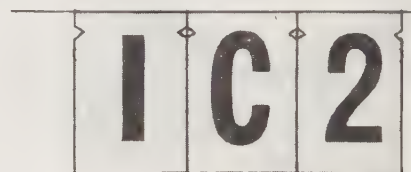
Align top edge of tape with guide line; press edge down with thumb; then press remainder of character firmly and carefully to surface.



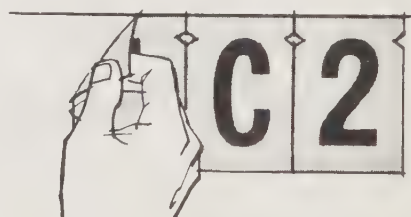
Squeegee character down firmly. Do not remove application tape at this time.



Repeat these steps for each remaining character. Align top edge with horizontal guide line. Put left edge of tape against right tape edge of last character. Check alignment of adjacent notches before pressing to surface.



When all legend characters are positioned, remove application tape. Starting at top left corner of each character, slowly and carefully peel tape down and back, flat against itself to prevent loosening of legend.



Re-squeegee entire legend.



Sealing Background and Legend

If the replacement sheeting extends to the top edge of the sign at any point and the sign is subjected to snow burial, place 3M Co. transparent film (No. 639) along the top edge of the sign. Center the film so edges extend down the sign face and back. This prevents ice crystals from delaminating the sheeting during prolonged snow burial.

For maximum durability, also daub a light coat of 3M Co. No. 700 edge sealer around edges of all new background sheeting and legend.

Safety

Personnel safety is a prime concern in performing sign maintenance. Crew supervisors must be familiar with the Forest Service Health and Safety Code (FSH 6709.11) and insure that field tasks are accomplished safely and efficiently.

To protect sign crews and road users alike, these rules regarding clothing, vehicles, and barricades will be compiled with:

- Maintenance personnel must wear reflective orange safety jackets or coveralls and hardhats.
- Equip maintenance vehicles with flashing lights and have a "Slow Moving Vehicle" sign properly displayed.
- Erect barricades, flashers, cones, and "Men Working" signs in work areas where roads are open to vehicle travel. See table 1 for proper lengths for closure lane widths, sign spacing, and cone and delineator spacing.

Typical barricades, cones, and signs are shown in the illustrations that follow. For further information refer to Part VI, "Construction and Maintenance," of the MUTCD, 1978 edition.

Table 1.—Proper sign and safety equipment placement at construction and maintenance sites

TAPER LENGTHS					SIGN SPACINGS			CONE AND DELINEATOR SPACING	
Approach speed (mph)	Closure distances (ft) for 3 lane widths			Recommended stopping sight dist. on level dry pavement (ft)	Speed (mph)	Minimum distance from taper to first sign (ft)	Separation of signs in series (ft)	Speed (mph)	Spacing (ft)
	10'	11'	12'						
15	150	165	180	66	To 25	250	300	15	15
20	200	220	240	96	30-35	300	300	20	20
25	250	275	300	125	40-45	400	500	25	25
30	300	330	360	158	50-55	500	500	30	30
35	350	385	420	197				35	35
40	400	440	480	236				40	40
45	450	495	540	281				45	45
50	500	550	600	327				50	50
55	550	605	660	380				55	55

STANDARD REGULATORY SIGN REQUIREMENTS FOR CONSTRUCTION AND MAINTENANCE

*M.U.T.C.D. CODE	**STD. SIZE	**MIN. SIZE	LEGEND
R1-1	30"X30"	24"X24"	STOP
R1-2	36"X36"X36"	30"X30"X30"	YIELD
R2-1	24"X30"	18"X24"	SPEED LIMIT (XX)
R2-5a	24"X30"	18"X24"	REDUCED SPEED AHEAD
R2-5b	24"X30"	18"X24"	REDUCED SPEED (X) M.P.H.
R2-5c	24"X30"	18"X24"	SPEED ZONE AHEAD
R4-1	24"X30"	18"X24"	DO NOT PASS
R4-2	24"X30"	18"X24"	PASS WITH CARE
R4-7	24"X30"	18"X24"	KEEP RT. (SYMBOL)
R4-7	24"X18"	18"X12"	KEEP RT. (PLAQUE)
R5-1	30"X30"	30"X30"	DO NOT ENTER
R5-9	36"X24"	30"X18"	WRONG WAY
R6-1	36"X12"	12"X36"	ONE WAY (IN ARROW) (RT. & LT.)
R6-2	18"X24"	18"X24"	ONE WAY WITH ARROW (RT. & LT.)
R8-3	24"X30"	18"X24"	NO PARKING
R11-2	48"X30"	48"X30"	ROAD CLOSED
R11-3a	60"X30"	60"X30"	ROAD CLOSED: LOCAL TRAFFIC ONLY
R11-4	60"X30"	60"X30"	ROAD CLOSED TO THRU TRAFFIC
R12-1	24"X30"	24"X30"	WT. LIMIT (X) TONS
R12-2	24"X30"	24"X30"	AXLE WT. LIMIT (X) TONS

* 1978 Edition

** Specified sizes are those coded as "Standard" in the Department of Transportation publication "Standard Highway Signs" (Edition of 1972). "Standard" size sign shall be required for all construction and maintenance activities on "arterial" roads, including both contract and force account work. "Minimum" size signs may be used for all construction and maintenance activities on "collector" and "local" roads, including both force account and contract work. All warning signs shall be black on orange. All regulatory signs shall be black on silver, except for "parking" signs which shall be red on silver. All signs shall conform with M.U.T.C.D. Part II, Sections A, B, and C, and Part VI of the 1978 Edition.

REGULATORY SIGN TABLE

STANDARD WARNING SIGN REQUIREMENTS

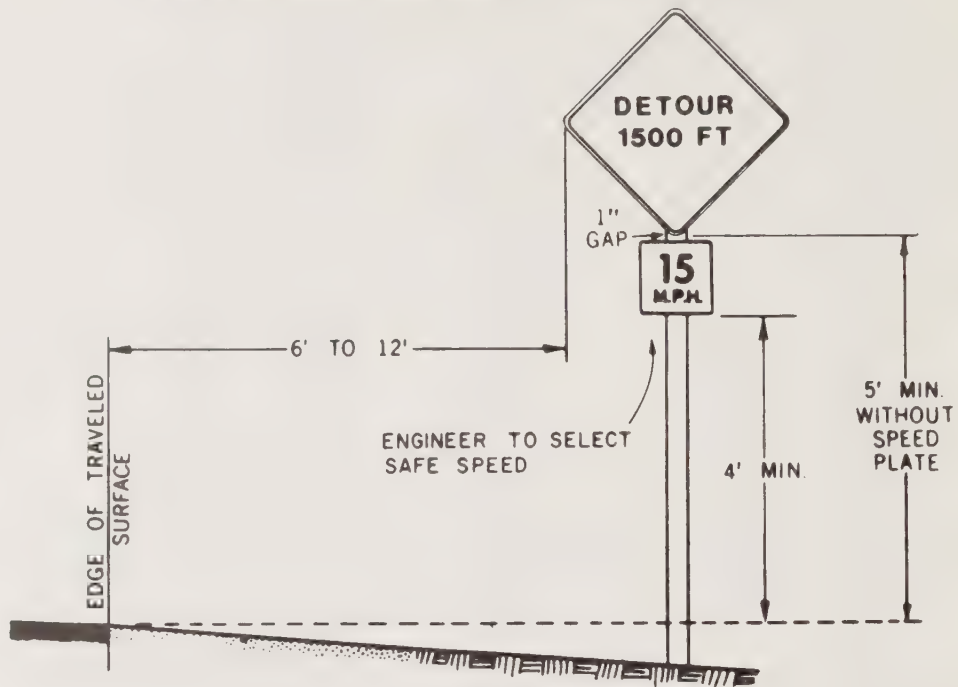
FOR CONSTRUCTION AND MAINTENANCE

*M.U.T.C.D. CODE	**STD. SIZE	** MIN. SIZE	LEGEND
W1-1	30"X30"	24"X24"	RT. & LT. TURN
W1-2	30"X30"	24"X24"	RT. & LT. CURVE
W1-3	30"X30"	24"X24"	SWITCHBACK TURN
W1-4	30"X30"	24"X24"	SWITCHBACK CURVE
W1-6	48"X24"	36"X18"	LARGE ARROW
W3-1	36"X36"	30"X30"	STOP AHEAD
W3-2	36"X36"	30"X30"	YIELD AHEAD
W4-2	36"X36"	30"X30"	ROAD NARROWS (SYMBOL)
W5-1	36"X36"	30"X30"	ROAD NARROWS
W5-2	30"X30"	24"X24"	NARROW BRIDGE
W5-3	36"X36"	30"X30"	ONE LANE BRIDGE
W6-3	30"X30"	24"X24"	TWO WAY TRAFFIC (SYMBOL)
W6-3	24"X18"	24"X18"	TWO WAY TRAFFIC (PLAQUE)
W8-1	30"X30"	24"X24"	BUMP
W8-2	30"X30"	24"X24"	DIP
W8-3	30"X30"	24"X24"	PAVEMENT ENDS
W8-4	30"X30"	24"X24"	SOFT SHOULDER
W8-5	30"X30"	24"X24"	SLIPPERY (SYMBOL)
W8-5	24"X18"	24"X18"	SLIPPERY WHEN WET (PLAQUE)
W9-1	30"X30"	24"X24"	RIGHT LANE ENDS (OR LT. LANE)
W9-2	36"X36"	30"X30"	MERGE LEFT (OR MERGE RT.)
W12-1	24"X24"	24"X24"	DOUBLE ARROW (ISLANDS)
W13-1	24"X24"	18"X18"	(XX) M.P.H. ADVISORY SPEED
W14-1	30"X30"	24"X24"	DEAD END
W14-3	36"X48"X48"	30"X40"X40"	NO PASSING ZONE (PENNANT)
W20-1	48"X48"	36"X36"	RD. CONST. (XXX) FT.
W20-2	48"X48"	36"X36"	DETOUR (XXX) FT.
W20-4	48"X48"	36"X36"	ONE LANE RD. (XX) FT.
W20-5	48"X48"	36"X36"	RT. LANE CLOSED (XX) MILE
W20-7	48"X48"	36"X36"	FLAGMAN (XXX) FT.
W21-1	30"X30"	30"X30"	MEN WORKING
W21-2	30"X30"	30"X30"	FRESH OIL
W21-3	36"X36"	30"X30"	RD. MACHINERY AHEAD
W21-4	36"X36"	30"X30"	RD. WORK (X) MILE
W21-5	30"X30"	24"X24"	SHOULDER WORK
W21-6	30"X30"	24"X24"	SURVEY CREW
W22-1	48"X48"	36"X36"	BLASTING ZONE (XX) FT.
W22-2	42"X36"	36"X30"	TURN OFF 2-WAY RADIO
W22-3	42"X36"	36"X30"	END BLASTING ZONE
G20-1	60"X36"	60"X36"	RD. CONST. (XX) MILES
G20-2	60"X24"	60"X24"	END CONSTRUCTION
G20-4	36"X18"	36"X18"	PILOT CAR FOLLOW ME
M4-9	30"X24"	30"X24"	DETOUR WITH ARROW (RT. & LT.)
M4-10	48"X18"	48"X18"	DETOUR IN ARROW (RT. & LT.)

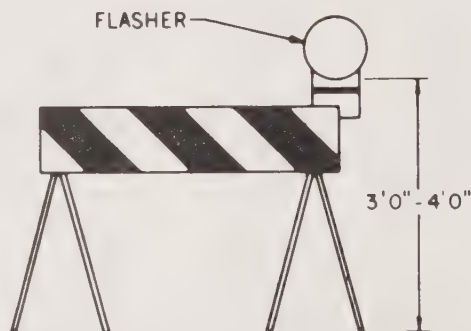
- 1978 Edition
- Specified sizes are those coded as "Standard" in the Department of Transportation Publication "Standard Highway Signs" (Edition of 1972). "Standard" size sign shall be required for all construction and maintenance activities on "arterial" roads, including both contract and force account work. "Minimum" size signs may be used for all construction and maintenance activities on "collector" and "local" roads, including both force account and contract work. All warning signs shall be black on orange. All regulatory signs shall be black on silver, except for "parking" signs which shall be red on silver. All signs shall conform with M.U.T.C.D. Part II, Sections A, B, and C, and Part VI of the 1978 Edition.

WARNING SIGN TABLE

STANDARD WARNING SIGN INSTALLATION
AND FLASHER USE REQUIREMENTS
FOR CONSTRUCTION AND MAINTENANCE



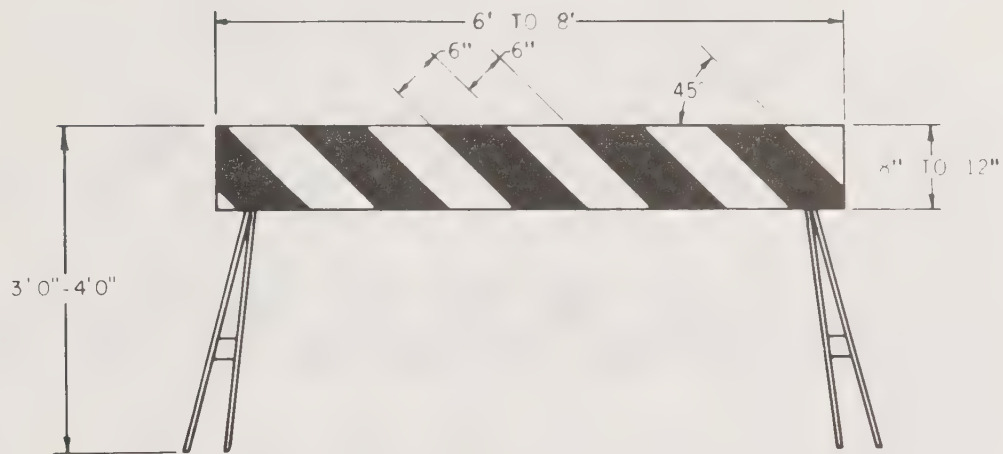
TYPICAL INSTALLATION DETAIL



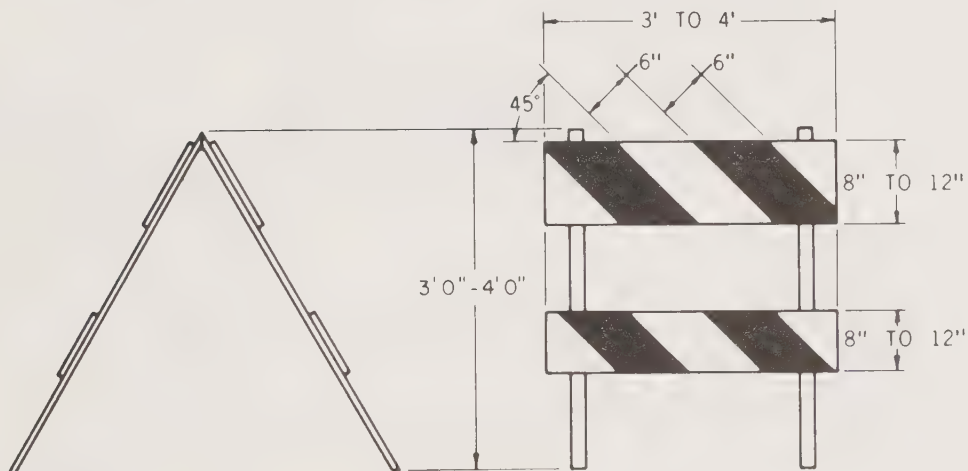
PORTABLE FLASHER SUPPORT
USE TYPE I OR TYPE II BARRICADE

TYPICAL SIGN INSTALLATION & FLASHER SUPPORT

STANDARD BARRICADE REQUIREMENTS FOR CONSTRUCTION AND MAINTENANCE



TYPE I BARRICADE
(ESSENTIALLY MOVABLE)



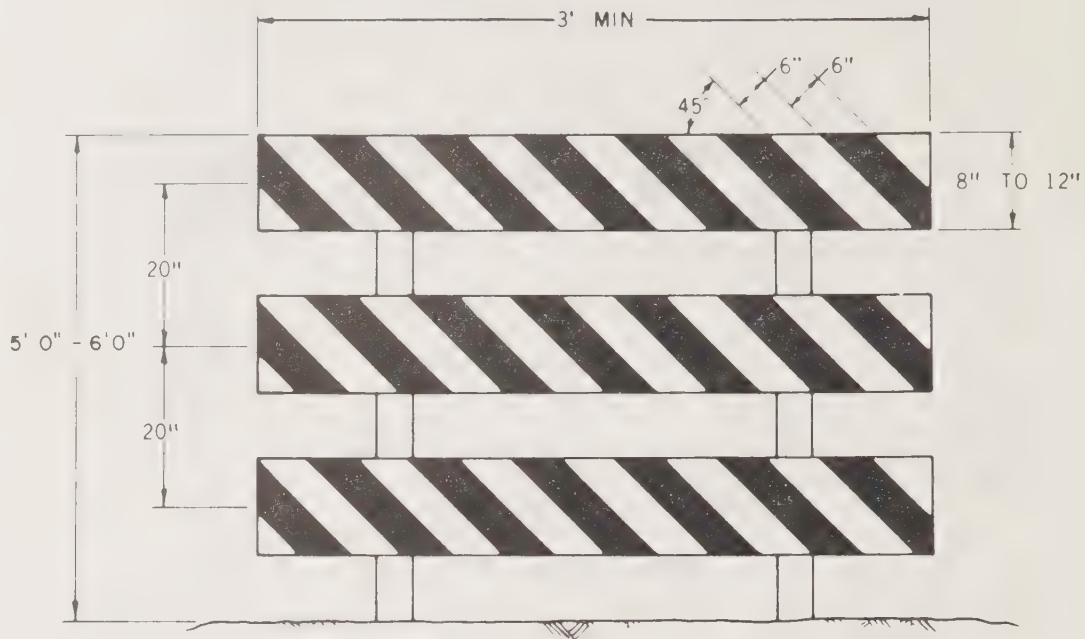
TYPE II BARRICADE
(PORTABLE)

NOTE: Barricade stripes shall be black on silver. Stripes shall be reflectorized material conforming to current Federal Specification LS-300c.

All other barricade components shall be painted white.

BARRICADES: TYPES I & II

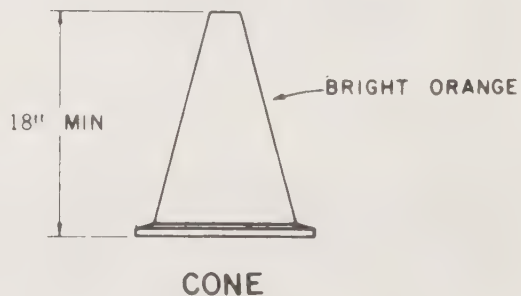
STANDARD BARRICADE & CONE REQUIREMENTS FOR
CONSTRUCTION AND MAINTENANCE



TYPE III BARRICADE
(ESSENTIALLY PERMANENT)

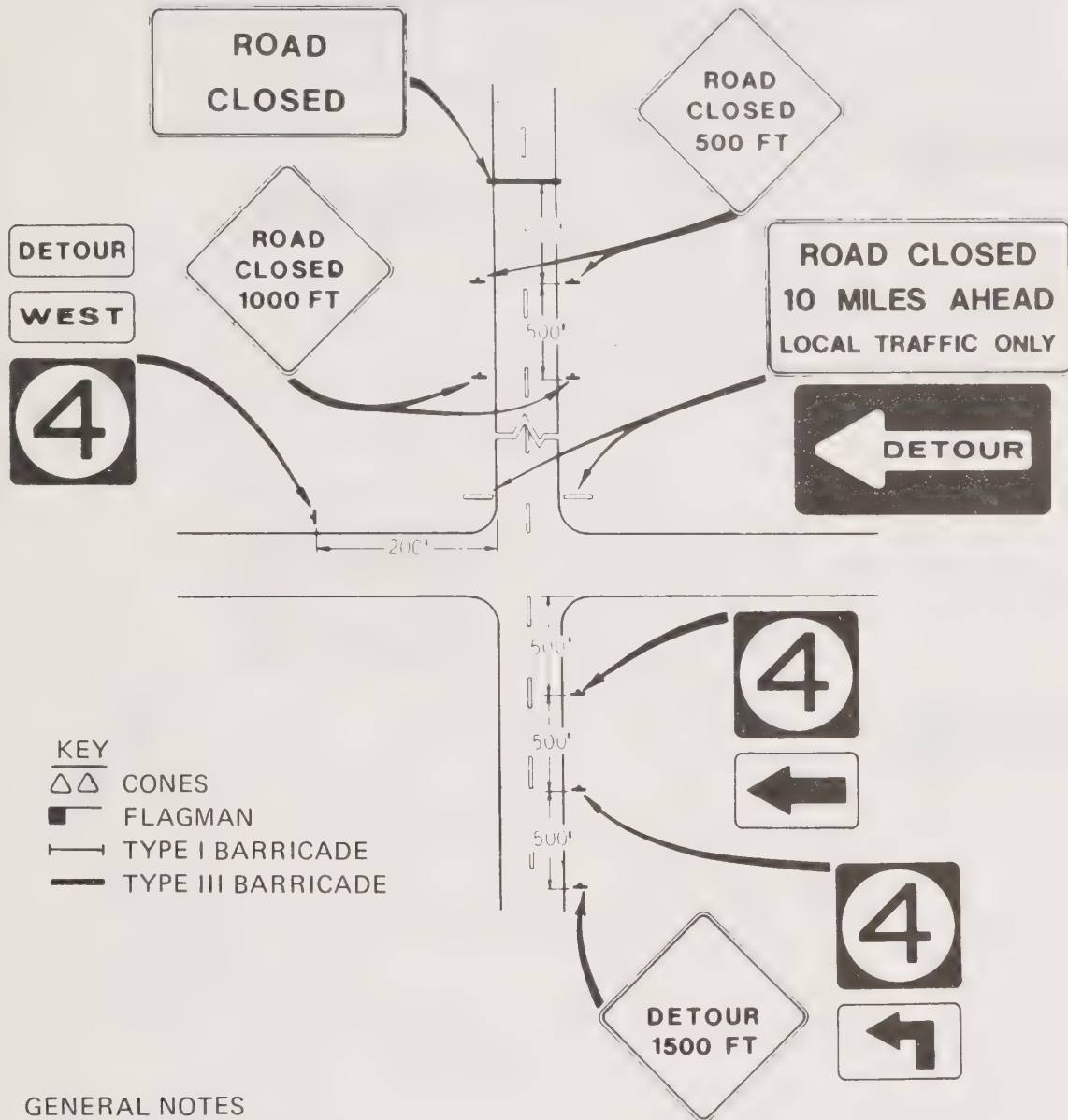
NOTE: Barricade stripes shall be black on silver. Stripes shall be reflectorized material conforming to current Federal Specification LS-300c.

All other barricade components shall be painted white.



BARRICADE: TYPE III & CONE DETAILS

**STANDARD DETOUR CONTROL APPLICATIONS
REQUIRED FOR CONSTRUCTION AND MAINTENANCE**



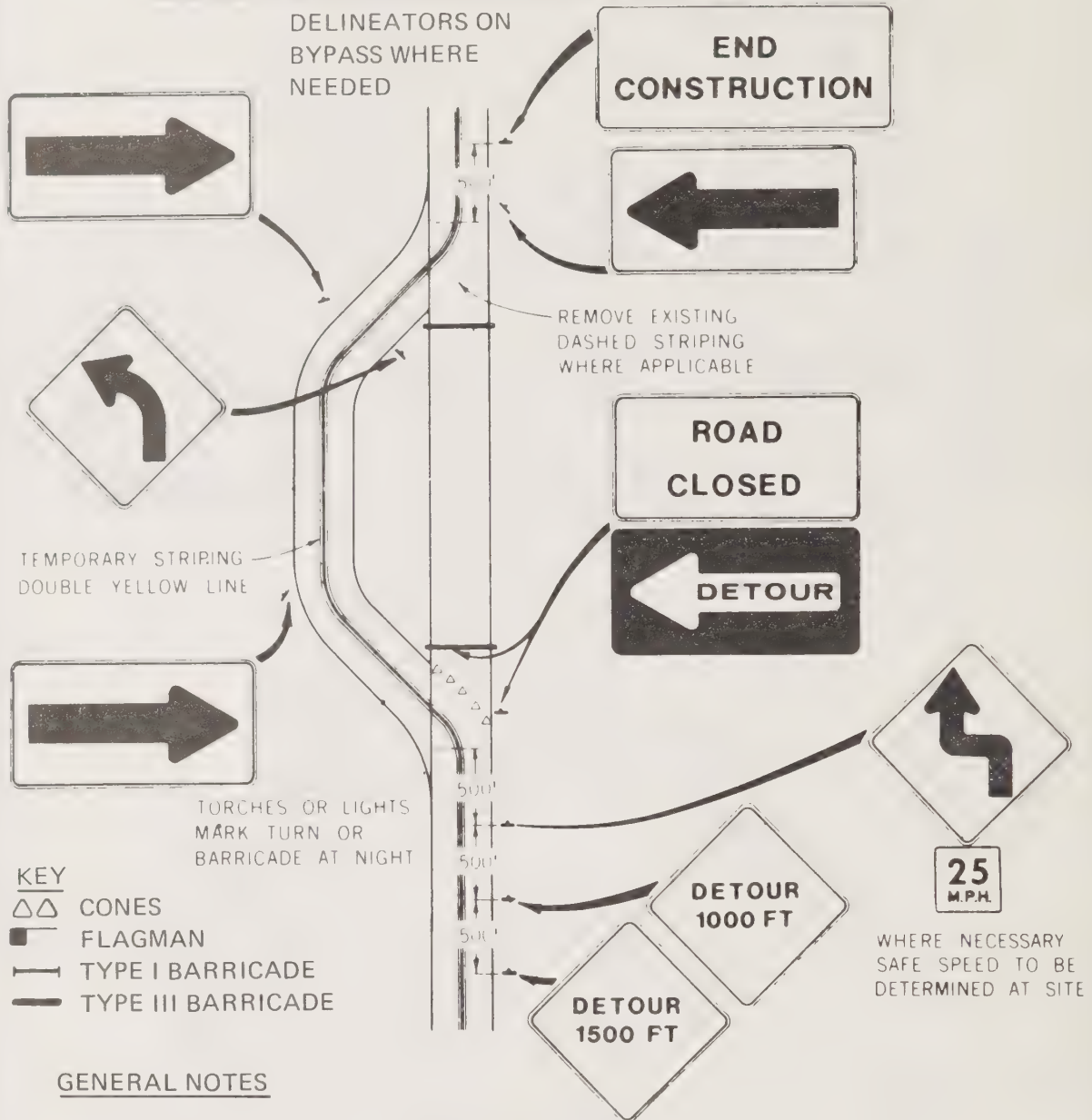
GENERAL NOTES

1. SIGNS ARE SHOWN FOR ONE DIRECTION OF TRAVEL ONLY. THE SAME NUMBER AND TYPES OF SIGNS SHALL BE PROVIDED FOR THE OPPOSITE DIRECTION OF TRAVEL.
2. TRAFFIC CONTROL DEVICES SHALL BE MAINTAINED FOR THE DURATION OF THE DETOUR.
3. COLORS, LETTER SERIES, AND REFLECTORIZATION SHALL CONFORM TO THE REQUIREMENTS OF SECTIONS 2A-11, 2A-15, 6B-1, AND 6B-2 OF THE 1971 EDITION OF THE FEDERAL MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.

CLASS 1

ROAD CLOSED BEYOND DETOUR POINT

STANDARD DETOUR CONTROL APPLICATIONS
REQUIRED FOR CONSTRUCTION AND MAINTENANCE



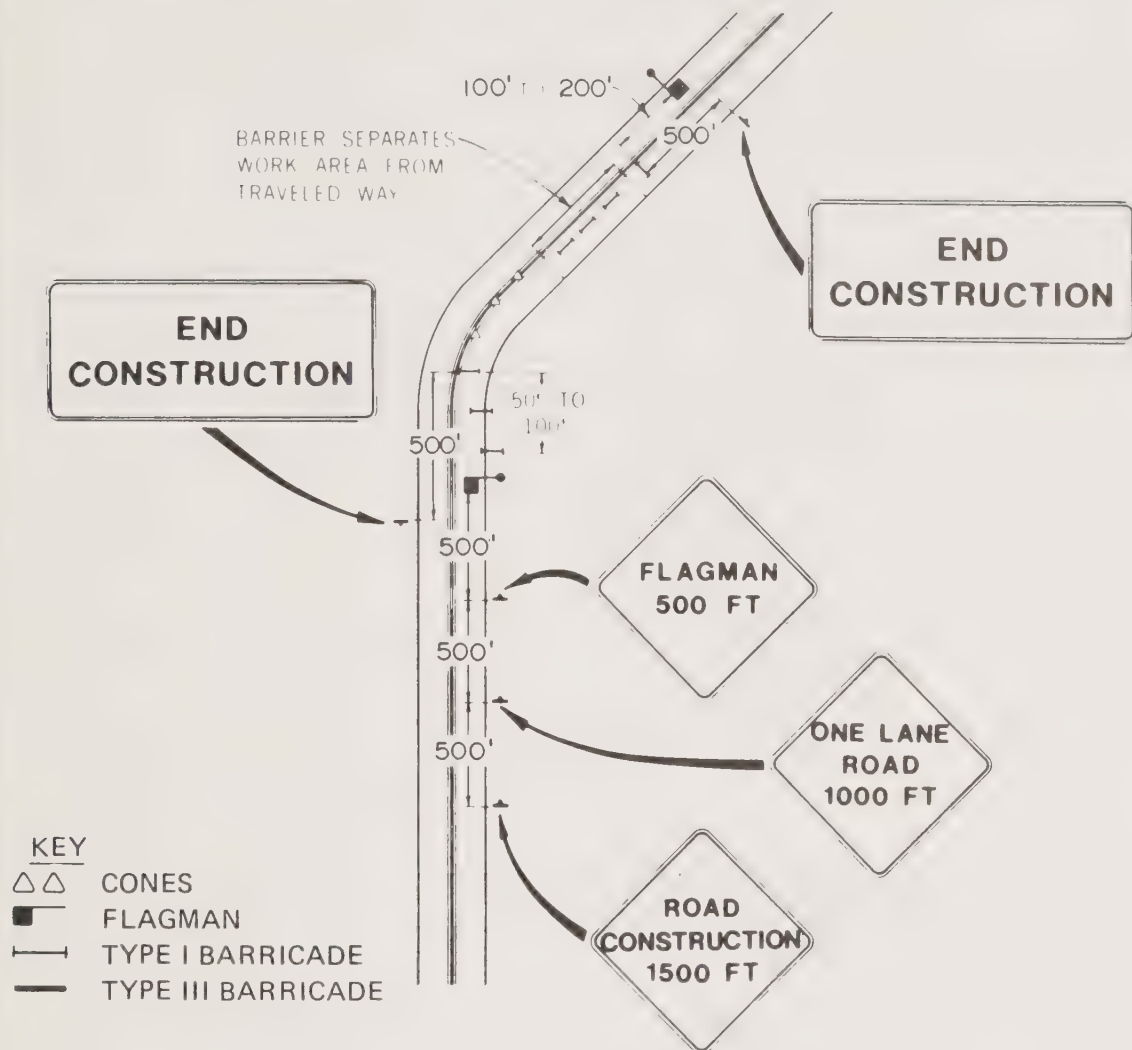
GENERAL NOTES

1. SIGNS ARE SHOWN FOR ONE DIRECTION OF TRAVEL ONLY. THE SAME NUMBER AND TYPES OF SIGNS SHALL BE PROVIDED FOR THE OPPOSITE DIRECTION OF TRAVEL.
2. TRAFFIC CONTROL DEVICES SHALL BE MAINTAINED FOR THE DURATION OF THE DETOUR.
3. COLORS, LETTER SERIES, AND REFLECTORIZATION SHALL CONFORM TO THE REQUIREMENTS OF SECTIONS 2A-11, 2A-15, 6B-1, AND 6B-2 OF THE 1971 EDITION OF THE FEDERAL MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.

CLASS 2

ROADWAY CLOSED BYPASS DETOUR PROVIDED

STANDARD DETOUR CONTROL APPLICATIONS
REQUIRED FOR CONSTRUCTION AND MAINTENANCE



GENERAL NOTES

1. SIGNS ARE SHOWN FOR ONE DIRECTION OF TRAVEL ONLY. THE SAME NUMBER AND TYPES OF SIGNS SHALL BE PROVIDED FOR THE OPPOSITE DIRECTION OF TRAVEL.
2. TRAFFIC CONTROL DEVICES SHALL BE MAINTAINED FOR THE DURATION OF THE DETOUR.
3. COLORS, LETTER SERIES, AND REFLECTORIZATION SHALL CONFORM TO THE REQUIREMENTS OF SECTIONS 2A-11, 2A-15, 6B-1, AND 6B-2 OF THE 1971 EDITION OF THE FEDERAL MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES.

CLASS 3

TWO LANE HIGHWAY WITH ONE LANE CLOSED

Materials and Handtools

This section lists the items needed to perform sign maintenance in the field. Quantities refer to minimum inventory needed at District level, or minimum order.

Supplies and Hardware		
Description	Quantity	Source
Face masks (GSA 42-00-856-9077)	100	GSA
84-package font, assorted capital letters	1 pkg.	3M Co.
font, assorted arrows and numerals	1 pkg.	"
3" x 150' roll No. 639 transparent film	1 roll	"
2" x 150' roll No. 639 transparent film	1 roll	"
No. 700 clear	4 qt cans	"
No. 711 thinner	4 qt cans	"
A-3 Activator	1-pt can	"
Ready-mix polysilicone alkyd resin exterior enamel, yellow cream, Fed. Stand. 595, color chip No. 23695	3 gal cans	Benjamin Moore Co.
Forest Products Laboratory cedar stain, Fed. Spec. TT-S-708A	3 gal cans	GSA
Black enamel (spray)		Local purchase
1½" x 50 yd. No. 425 UAL aluminum foil tape	1 roll	3M Co.
Brown reflective sheeting	1 roll	"
Xylol		Local purchase
VM&P naphtha		"
Wood filler		"
Assorted paint brushes		"
Artists paint brushes		"
Polysponge rollers & pans		"
Vandal warning decals		Fed. Prison Industries, Lompoc, Calif.; Atlanta, Ga.

Supplies and Hardware (cont.)

Description	Quantity	Source
Anti-theft fasteners	100	Ojo Caliente Craftsmen Inc. Ojo Caliente, N. Mex.
Neoprene or nylon washers		Federal Prison Industries; Ojo Caliente Craftsmen Inc. Local purchase
5/16-in-dia & 3/8-in-dia carriage bolts with Hex nuts		Local purchase
"Teenut" pallet fasteners		Carr Fastener Co., Cambridge, Mass.
Blind aluminum rivets		Local purchase
Aluminum fluted nuts		Federal Prison Industries
Vandlgard-Nut assembly		Federal Prison Industries; Voi-Shan, Culver City, Calif.

Sign Posts

Description	Quantity	Source
3" x 1½" x 4' U channel for delineator replacement	6	Local purchase
4" x 6" x 8' wood	6	"
4" x 6" x 10' wood	6	"
4" x 6" x 12' wood	6	"
2" x 2" x 8' Telespare with sleeves	6	Unistrute Corp.
2" x 2" x 12' Telespare with sleeves	6	"

Handtools

Description	Quantity	Source
Weed cutter (GSA 3750-00-239-8677)	1	GSA
3 cu ft utility wheelbarrow (GSA 3920-00-640-9236)	1	"
Brace bit ratchet, 10-in sweep (GSA 5510-00-293-1958)	1	"
Mixed set of woodworking chisels (GSA 5100-00-585-8429, GSA 5100-00-585-8431, GSA 5100-00-585-8432)	1	"
Mixed set of cold chisels (GSA 5110-00-234-1944)	1	"
Paint scraping knife, 3" x 4½" (GSA 5110-00-223-8827)	1	"
Crosscut handsaw, 26 in (GSA 5110-00-142-5004)	1	"
Ripcut handsaw, 26 in (GSA 5110-00-142-5015)	1	"
Post hole auger	1	Local purchase
Post hole digger (GSA 5120-00-223-8426)	1	GSA
Post hole breaker bar	1	Local purchase
27-30 lb slip hammer, double handle, 3 in id	1	"
20-lb double face hammer, (GSA 5120-00-230-7843)	1	GSA
6-lb double face hammer (GSA 5120-00-265-7462)	1	"
Curved claw hammer, 20-oz (GSA 5120-00-194-1643)	1	"
Hand shovel, long handle (GSA 5120-00-965-0609)	1	"
Tacker staple gun, heavy-duty, (GSA 5120-00-769-8706)	1	"
Step ladders, heavy-duty 4 ft (GSA 5440-00-227-1592) 10 ft (GSA 5440-00-227-1595)	1	"
Sign post step	1	GSA or Lily Signs Co.

Signs		
Description	Quantity	Source
Hazard signs, for work vehicle only	4	From normal sign manufacturer
Delineators (spares for replacements)	50	"
Stops (replacements)	5	"
Yields (replacements)	5	"
Barricades (emergency)	5	"
Hazards (replacement or emergency)	5	"
Detour, road closures	5	"

In addition to the materials and handtools listed here, your supplies should include mild solvents, such as mineral spirits; mild detergent; bleach; sponges, fine steel wool; plenty of clean rags; and a container that holds at least 50 gallons of water.

Documentation

Every unit with sign maintenance responsibilities should have copies of these documents:

- Up-to-date *Manual of Uniform Traffic Control Devices*.
- Forest Service *Catalog of Posters and Signs* Forest Service Handbook (FSH 7109.11a).
- Forest Service *Specifications and Drawings for Manufacturing of Signs* (FSH 7109.11b).



Commercial Sign Repair Kits

This section identifies two sources for obtaining ready-made sign maintenance kits. The contents can serve as a guide for units developing their own kits.

Ojo Caliente Craftsmen, Inc.			
Description	Size	Unit	Quantity
Brown reflective sheeting	6" x 10 yd	Roll	2
Silver reflective sheeting	6" x 5 yd	Roll	1
Black No. 3655 sheeting	9/16" x 50 yd	Roll	1
Yellow reflective sheeting	6" x 10 yd	Roll	1
Red reflective sheeting	6" x 6"	Sheet	20
Prespaced diecut 1 pkg. each alphabet (A-Z)	4-in, Series C	10/pkg	26
Prespaced diecut numerals (0-9) 1 pkg. each	4-in, Series C	10/pkg	10
Arrows	4" x 6"	5/pkg	3
Radius corners (for borders)	½" x ½"	25/pkg	1
Sign border material	½" x 50 yd	Roll	1
Transparent film No. 639	3" x 50 yd	Roll	1
Plastic applicator squeegee	---	Each	3
Aluminum tape	½" x 50 yd	Roll	1
Dauber can, No. 700 clear	8 oz	Can	1
Scissors	8 in	Each	1
Single edge razor blades	---	Pkg	1
Plywood cutting block	¾" x 6" x 6"	Each	1
Adhesive activator	1 pt	Each	1
Aerosol flat black paint	13 oz	Can	1
Flat dolly	---	Each	1
Ball peen hammer	---	Each	1
This kit is shipped in two steel tool boxes and costs \$450 f.o.b. Ojo Caliente, N. Mex. To order, write:			
Ojo Caliente Craftsmen, Inc. P.O. Box 67 Ojo Caliente, N. Mex. 87549			

3M Co.

The 3M Co. kit—BHK-1 Sign Patching Kit—is primarily for repairing reflective signs of aluminum. When ordering, specify brown engineering-grade reflective sheeting in place of the green normally stocked in this kit.

Description	Size	Unit	Quantity
No. 425 foil tape	1½" x 60 yd	Roll	4
No. 3271 Yellow	2½" x 10 yd	Roll	1
No. 3290 White	2½" x 10 yd	Roll	4
No. 3277 Green	2½" x 10 yd	Roll	1
No. 3290 silk screen with No. 712 stop sign red	2½" x 54"	Piece	7
No. 3655 Black	2½" x 10 yd	Roll	1
Scissors	—	Pair	1
Machinist hammer	16 oz	Each	1
No. 1454 fender dolly	2½ lb	Each	1
No. 700 clear	8 oz	Can	1
A-3 Activator	4 oz	Can	1
Squeegees	—	Each	5

NOTE: 3M is changing this kit for Forest Service use to:

2 rolls of white
2 rolls of brown, no green

Order from:

3M Co.
Reflective Products Division
St. Paul, Minn. 55101

The kit costs \$89.95 plus shipping (1979 price).

Heavy-Duty Equipment

This section identifies a commercial unit for cleaning signs, pneumatic tools for quickly and efficiently accomplishing extensive sign repairs in the field, as well as detailed drawings for converting a truck into a complete sign maintenance vehicle.

Sign Cleaning Unit

A special sign cleaning unit that fits in a truck is a useful sign maintenance tool. The "Highway Handyman" model 10-50, or equivalent, is a good example. The "Highway Handyman" is a multipurpose unit that also can be used for cleaning Forest Service vehicles, buildings, etc. It has a 3.5 horsepower gasoline engine and 90-gallon mixing tank. It measures 24 inches wide by 48 inches long by 18 inches high and weighs 200 pounds empty and 968 pounds full. The cost is approximately \$925 f.o.b. Source: Highway Sign Cleaner Co., 810 Cromwell Ave., St. Paul, Minn.

Air Compressor

An air compressor is needed for all pneumatic tools and paint spraying equipment. Specifications: 18 to 23 cubic feet displacement; 18 cubic feet free air; 6 horsepower gasoline engine; 30-gallon air storage tank; 150 to 1,750 pounds per square inch available pressure; 12-volt dc starter system with batteries. Estimated cost: \$1,200. Sources: Sears Roebuck and Co., McMaster Carr, Chicago Pneumatic Tool Co.

Compressor regulator, filter, oiler: \$100 estimated cost. Sources: Sears Roebuck and Co., McMaster Carr, Chicago Pneumatic Tool Co.

Hose reel for 100 feet of ½-inch hose: \$100. Sources: General Services Administration; Chicago Pneumatic Tool Co. 100-foot roll of ½-inch hose: \$100 estimated cost. Sources: GSA, Chicago Pneumatic Tool Co., McMaster Carr.

Pneumatic Tools		
Description	Quantity	Est. Cost
Router and router bit set	1	\$100
Orbital sander	1	80
3/8-in drill motor variable speed	1	125
Drill bits 1/8-1/2 in	1 set	25
1/4-in impact wrench	1	170
Impact sockets, 1/4-in	1 set	20
Hammer, aircraft cold rivet, GSA Tool Catalog	1	See current GSA cost schedule
Circular saw, 12 in (GSA 5130-00-239-5813)	1	"
Scaling, chipping attachment with pneumatic drill (GSA 5130-00-910-3083)	1	"
Double-sided handle drill, 3/8-in size, 1,600 rpm, 90° angle drive (GSA 5130-00-540-4434)	1	"
1 each 1/4-in reversible drill motor, 3,200 rpm (GSA 5130-00-889-9011)	1	"
Sources for pneumatic tools include: General Services Administration; McMaster Carr; Sears Roebuck and Co.; Chicago Pneumatic Tool Co.		

Sign Maintenance Vehicle

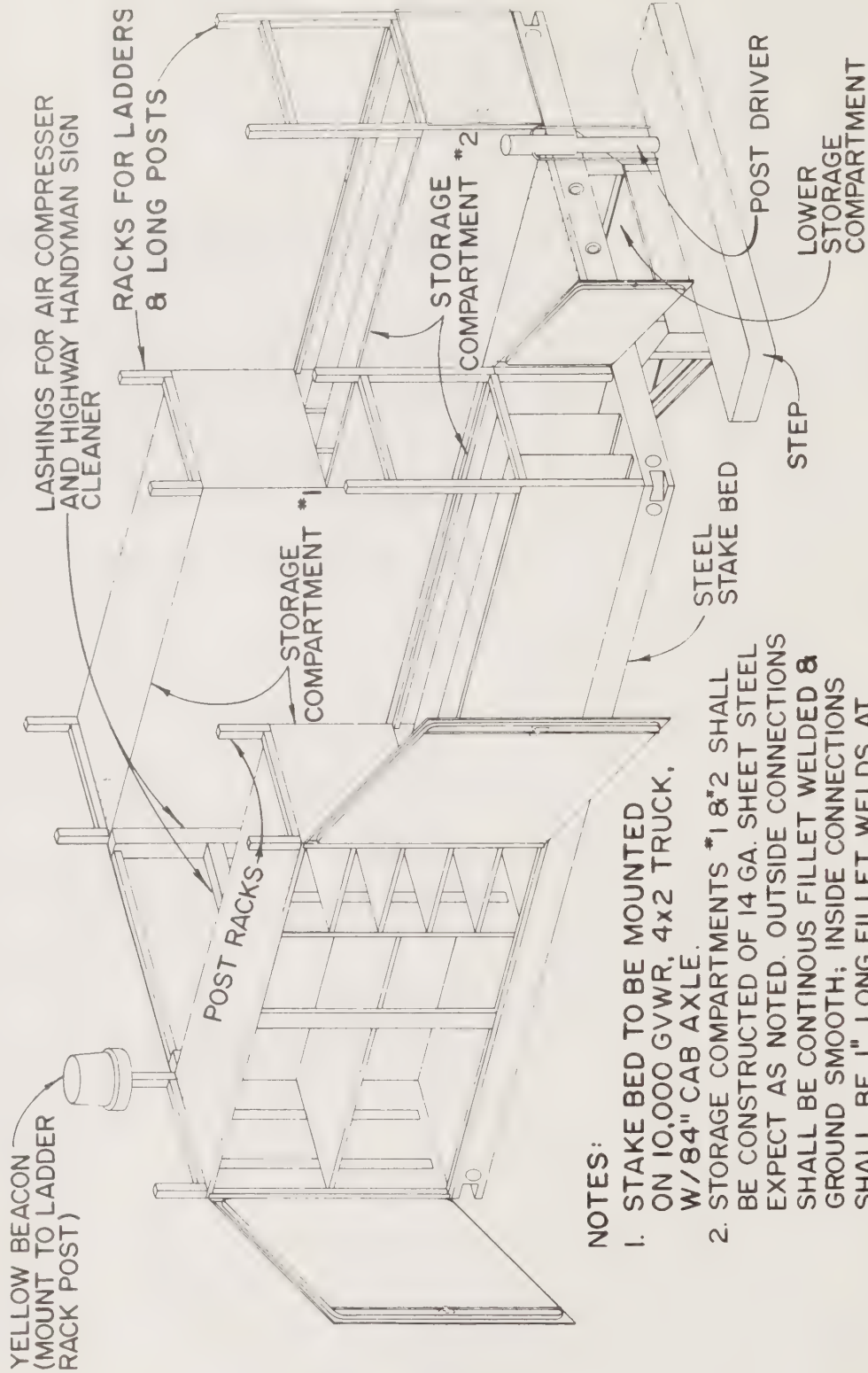
A truck designed specifically for sign maintenance can make field repair much easier. Detailed drawings for the sign maintenance package are shown on pages 48 through 54. It is strongly recommended that fabrication and installation of the body and major equipment such as a highway handman type sign cleaning unit and air compressor be done by the same contractor.

These specifications are recommended for the sign maintenance vehicle:

- 1-ton truck—10,000 GVW class (minimum size)
- V-8 engine
- large, heavy-duty radiator
- 4-speed transmission
- 3:8-4:1 axle ratio
- long wheelbase
- power steering
- dual rear mud and snow tires

Estimated cost: \$7,000 (1979 GSA price).

STAKE BED W/STORAGE COMPARTMENTS (Perspective View)

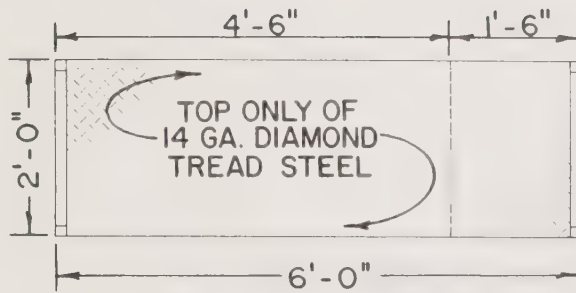


NOTES:

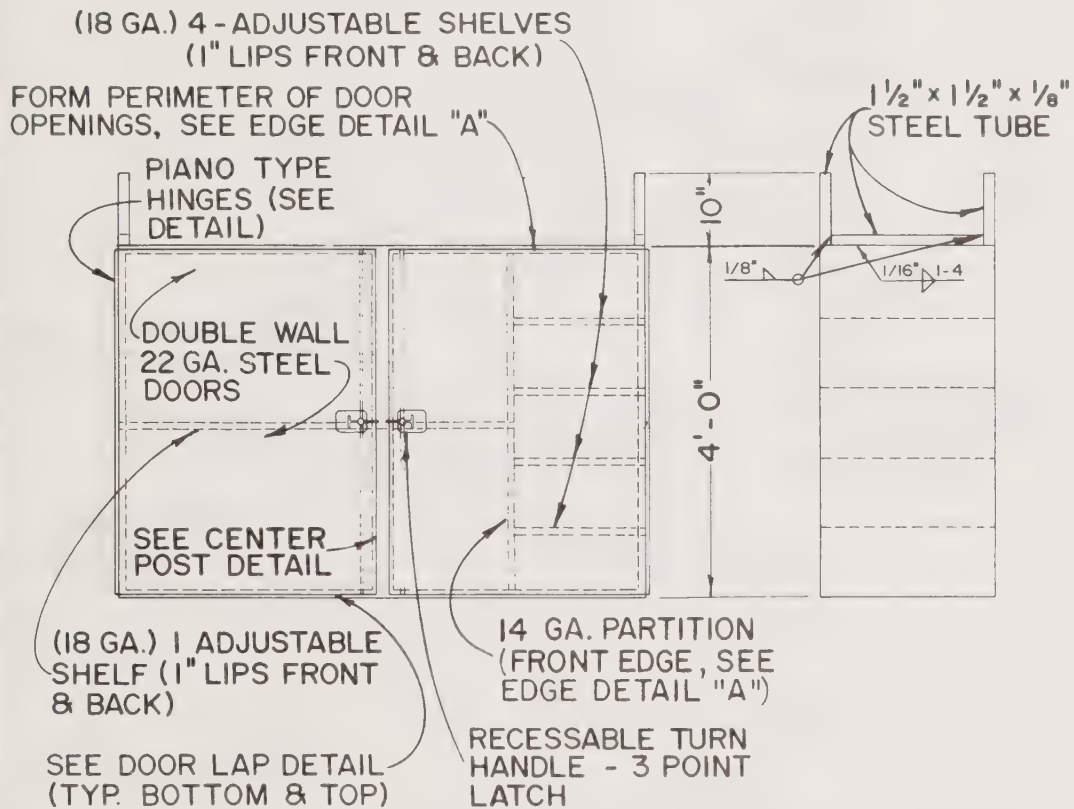
1. STAKE BED TO BE MOUNTED ON 10,000 GVWR, 4x2 TRUCK, W/84" CAB AXLE.
2. STORAGE COMPARTMENTS *18"2 SHALL BE CONSTRUCTED OF 14 GA. SHEET STEEL EXPECT AS NOTED. OUTSIDE CONNECTIONS SHALL BE CONTINUOUS FILLET WELDED & GROUND SMOOTH; INSIDE CONNECTIONS SHALL BE 1" LONG FILLET WELDS AT 4" O.C.
3. CAP ALL OPEN ENDS OF TUBING.
4. WELD STORAGE COMPARTMENTS TO STAKE BED. (SEE SPECS.)
5. SPARE TIRE SHALL BE MOUNTED BETWEEN TRUCK FRAME CHANNELS.

STORAGE COMPARTMENTS #1

PLAN, FRONT ELEVATION, SIDE ELEVATION



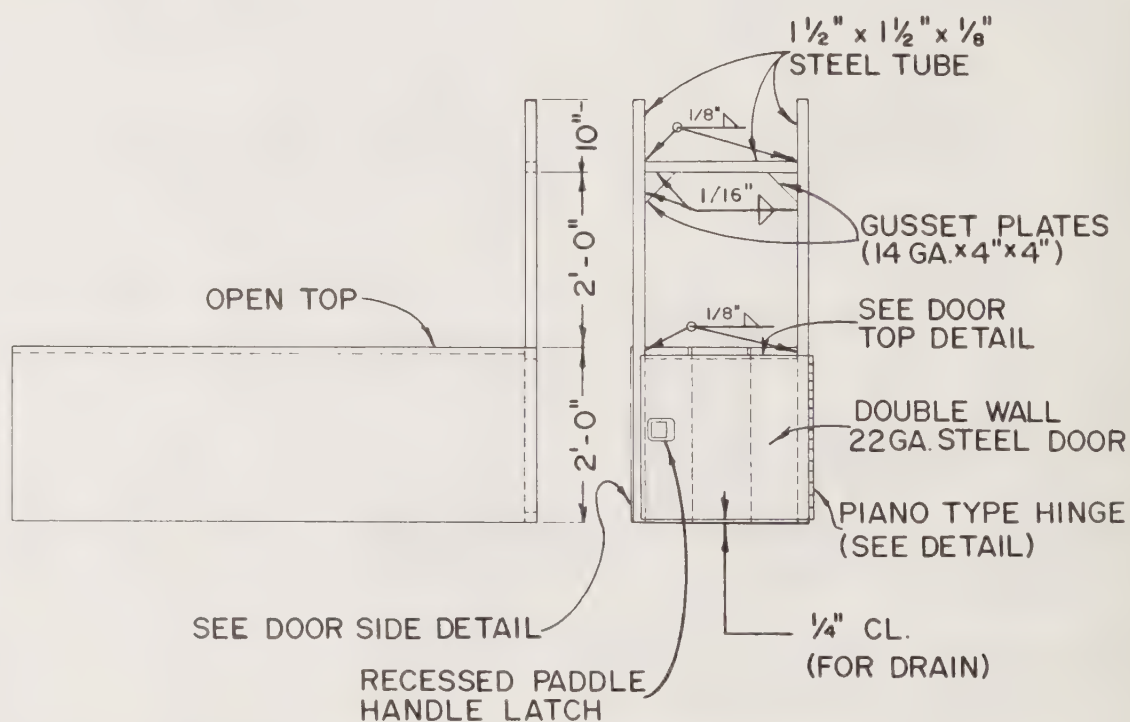
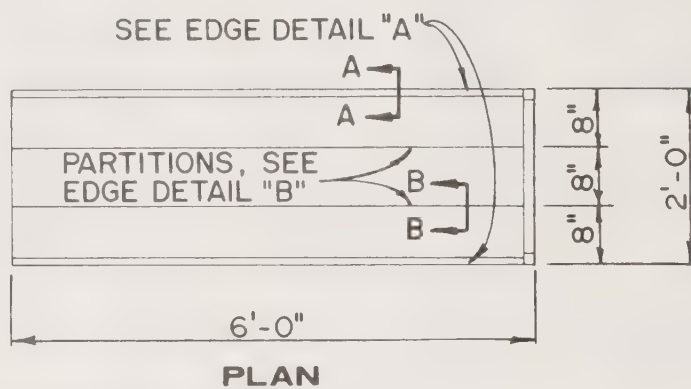
PLAN



FRONT ELEVATION

SIDE ELEVATION

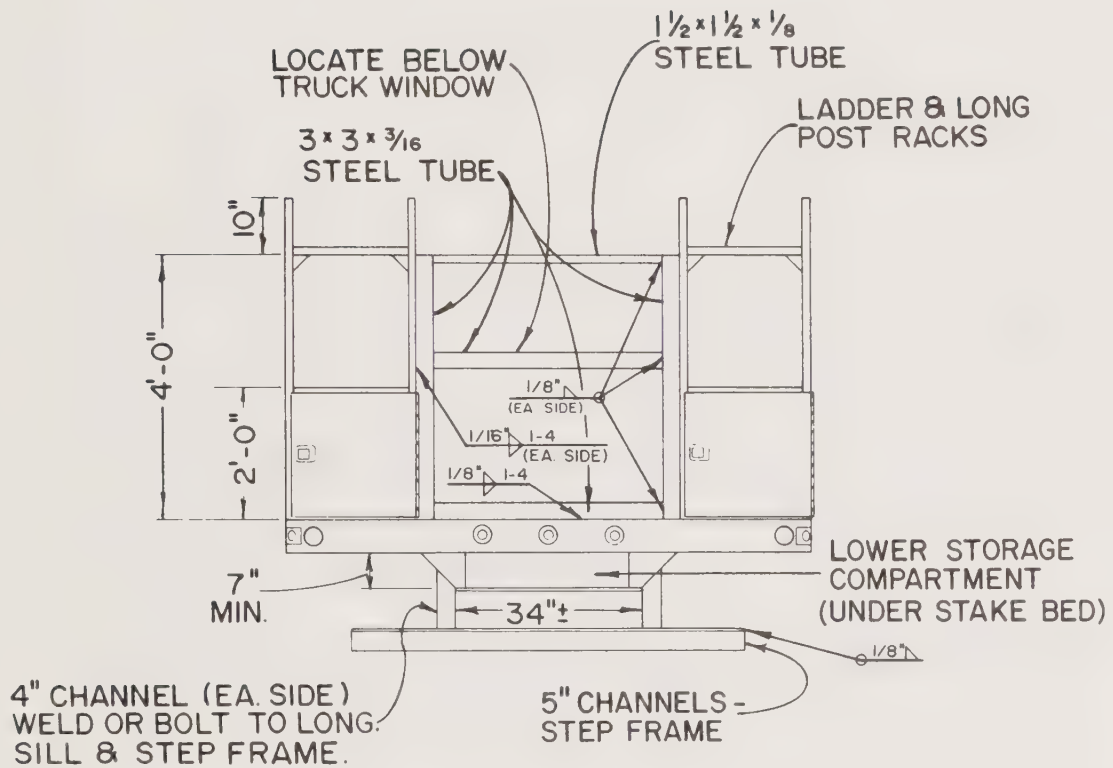
STORAGE COMPARTMENTS #2 **PLAN, SIDE ELEVATION, END ELEVATION**



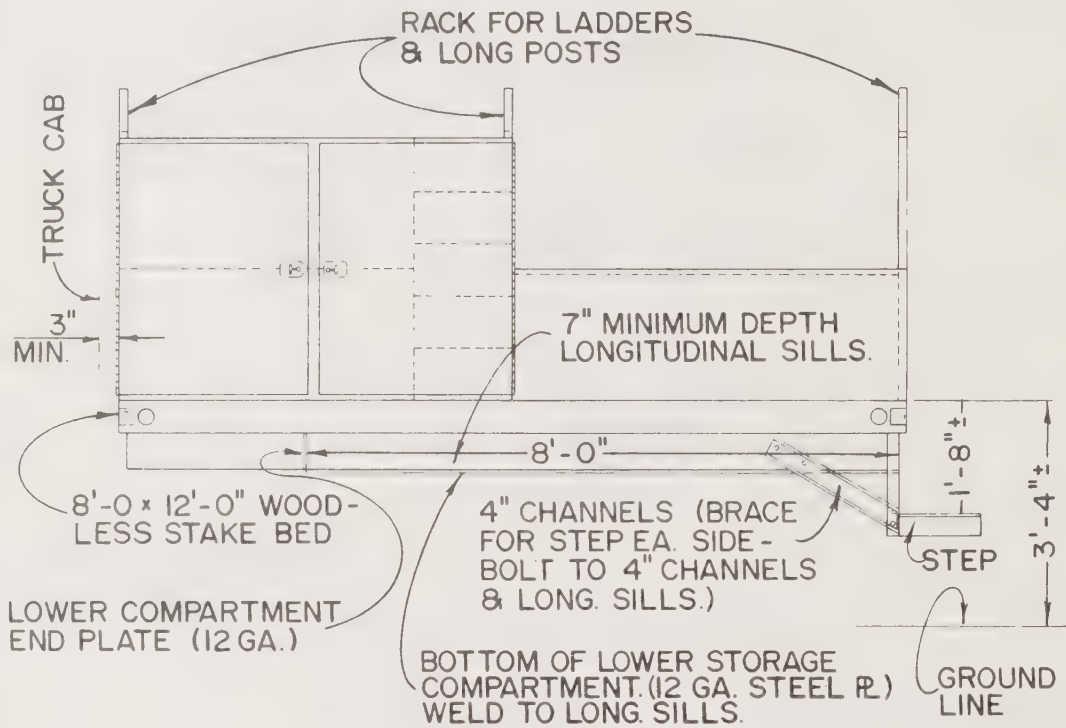
SIDE ELEVATION

REAR ELEVATION

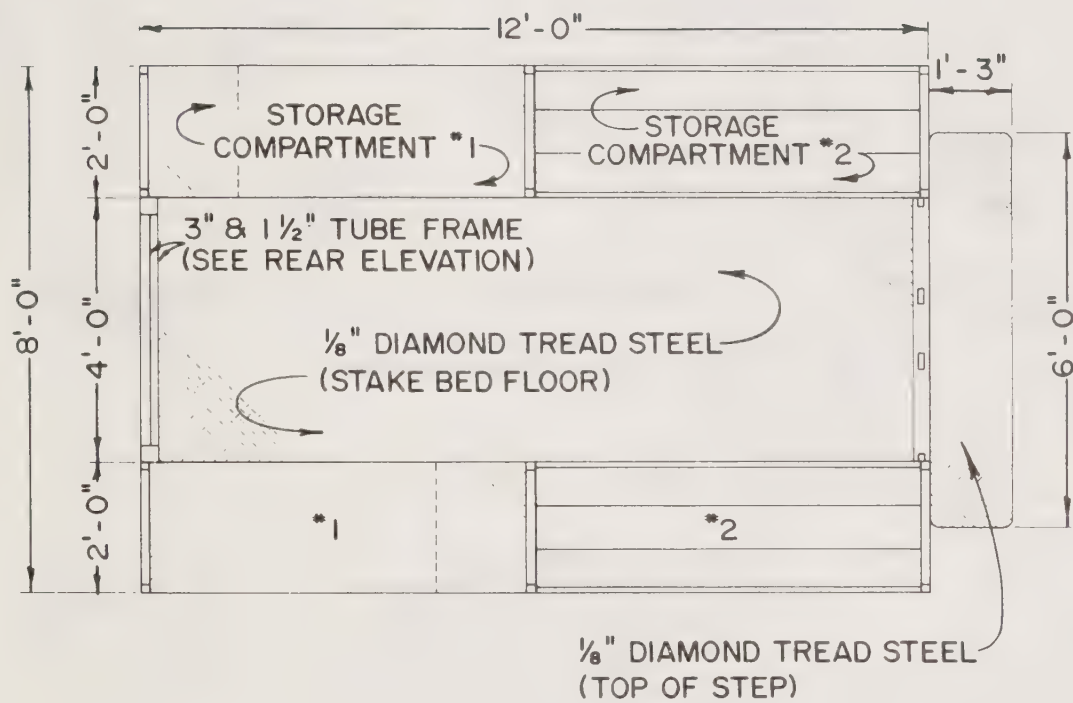
STAKE BED W/ STORAGE COMPARTMENTS REAR ELEVATION



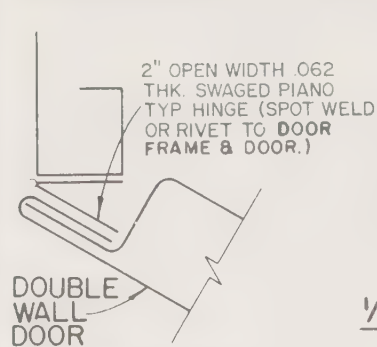
STAKE BED W/ STORAGE COMPARTMENTS SIDE ELEVATION



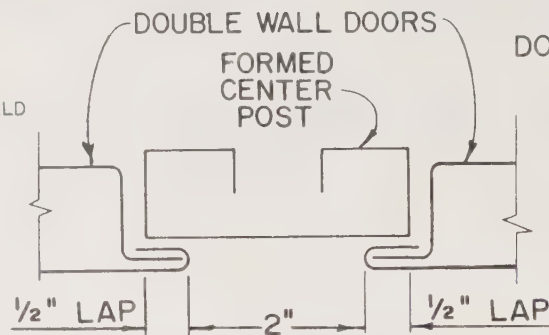
STAKE BED W/ STORAGE COMPARTMENTS PLAN



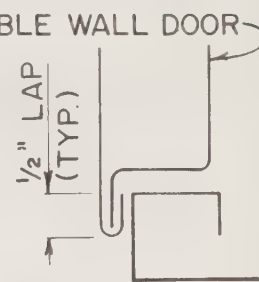
STORAGE COMPARTMENTS DETAILS & NOTES



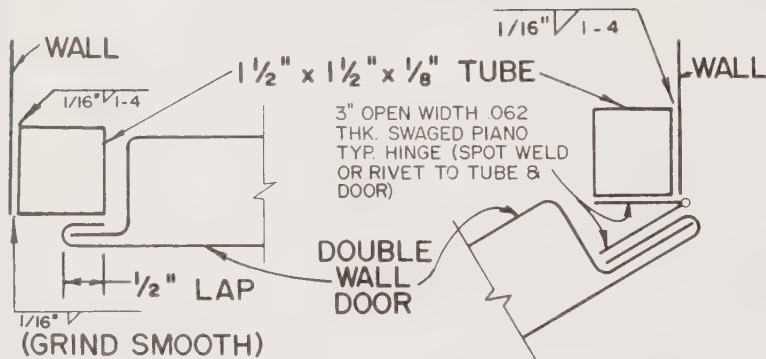
HINGE DETAIL



CENTER POST DETAIL
STORAGE COMPARTMENT #1

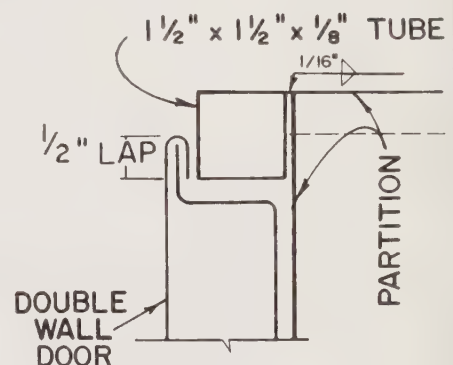


DOOR LAP DETAIL

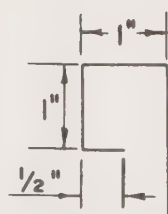


DOOR SIDE DETAIL

HINGE DETAIL
STORAGE COMPARTMENT #2



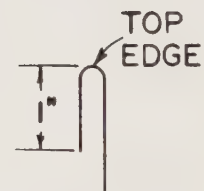
DOOR TOP DETAIL



SECTION A-A
EDGE DETAIL "A"

NOTES:

1. STAKE BED TO BE MOUNTED ON 10,000 GVWR, 4x2 TRUCK, W/84" CAB AXLE
2. STORAGE COMPARTMENTS "1 & 2" SHALL BE CONSTRUCTED OF 14 GA. SHEET STEEL EXCEPT AS NOTED. OUTSIDE CONNECTIONS SHALL BE CONTINUOUS FILLET WELD, GROUND SMOOTH; INSIDE CONNECTIONS SHALL BE 1" LONG FILLET WELDS AT 4" O.C.
3. CAP ALL OPEN ENDS OF TUBING.
4. WELD STORAGE COMPARTMENTS TO STAKE BED. (SEE SPECS.)
5. SPARE TIRE SHALL BE MOUNTED BETWEEN TRUCK FRAME CHANNELS.
6. MANUFACTURER'S STANDARD CONSTRUCTION DETAILS MAY BE USED WITH PRIOR APPROVAL.

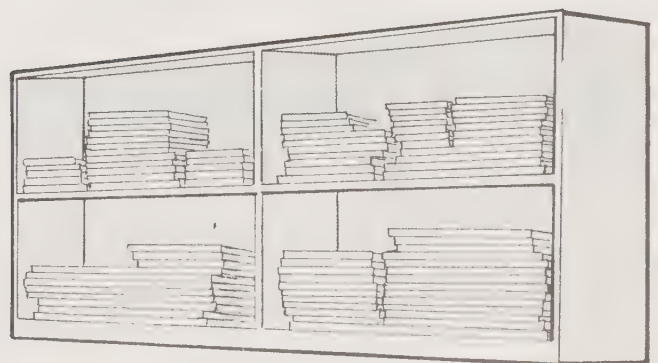
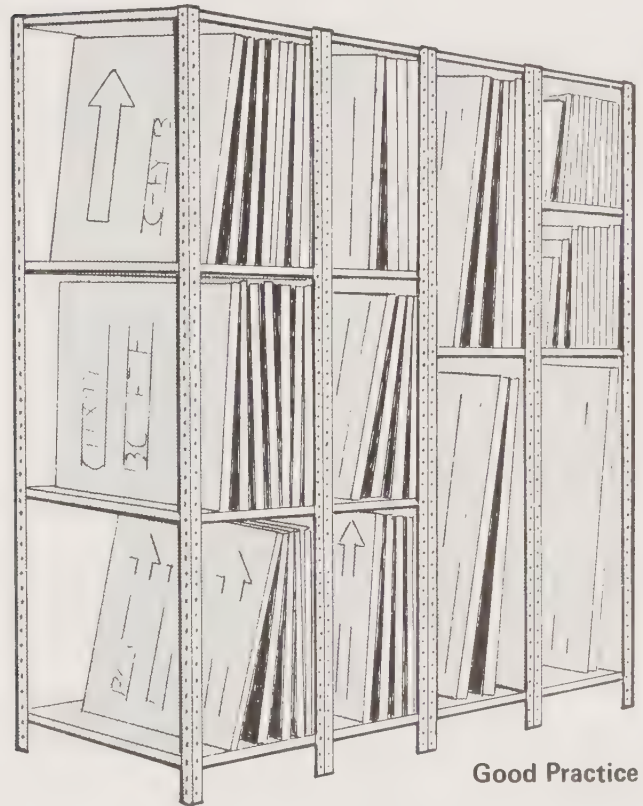


SECTION B-B
EDGE DETAIL "B"

Sign Storage

Remove all packing material and slip sheeting so nothing is against sign face. Do not lay signs down or leave in low areas where dirt or water may contact sign face. Do not permit treated wood posts or other materials to lie against sign face. Store inside.

Adjustable/square tubing or angle material makes a good storage rack for proper sign storage.



Bad Practice

Highway Safety Program Standard 13¹

TRAFFIC ENGINEERING SERVICES

Purpose

To assure the full and proper application of modern traffic engineering principles and uniform standards for traffic control to reduce the likelihood and severity of traffic accidents.

Standard

Each State, in cooperation with its political subdivisions, and each Federal department or agency which controls highways open to public travel or supervises traffic operations, shall have a program for applying traffic engineering measures and techniques, including the use of traffic control devices, to reduce the number and severity of traffic accidents.

I. The program as a minimum shall consist of:

A. A comprehensive manpower development plan to provide the necessary traffic engineering capability, including:

1. Provisions for supplying traffic engineering assistance to those jurisdictions unable to justify a full-time traffic engineering staff.

2. Provisions for upgrading the skills of practicing traffic engineers, and providing basic instruction in traffic engineering techniques to sub-professionals and technicians.

B. Utilization of traffic engineering principles and expertise in the planning, design, construction, and maintenance of the public roadways, and in the application of traffic control devices.

C. A traffic control devices plan including:

1. An inventory of all traffic control devices.

2. Periodic review of existing traffic control devices, including a systematic upgrading of sub-standards issued or endorsed by the Federal Highway Administrator.

3. A maintenance schedule adequate to insure proper operation and timely repair of control devices, including daytime and nighttime inspections.

4. Where appropriate, the application and evaluation of new ideas and concepts in applying control devices and in modifying existing devices to improve their effectiveness through controlled experimentation.

D. An implementation schedule to utilize traffic engineering manpower to:

1. Review road projects during the planning, design, and construction stages to detect and correct features that may lead to operational safety difficulties.

2. Install safety-related improvements as a part of routine maintenance and/or repair activities.

3. Correct conditions noted during routine operational surveillance of the roadway system to rapidly adjust for the changes in traffic and road characteristics as a means of reducing accident frequency or severity.

4. Conduct traffic engineering analyses of all high accident locations and develop corrective measures.

5. Analyze potentially hazardous locations, such as sharp curves, steep grades, and railroad grade crossings and develop appropriate counter-measures.

6. Identify traffic control needs and determine short- and long-range requirements.

7. Evaluate the effectiveness of specific traffic control measures in reducing the frequency and severity of traffic accidents.

8. Conduct traffic engineering studies to establish traffic regulations such as fixed or variable speed limits.

II. This program shall be periodically evaluated by the State, or appropriate Federal department or agency where applicable, and the Federal Highway Administration shall be provided with an evaluation summary.

¹ Administered by the Federal Highway Administration.

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